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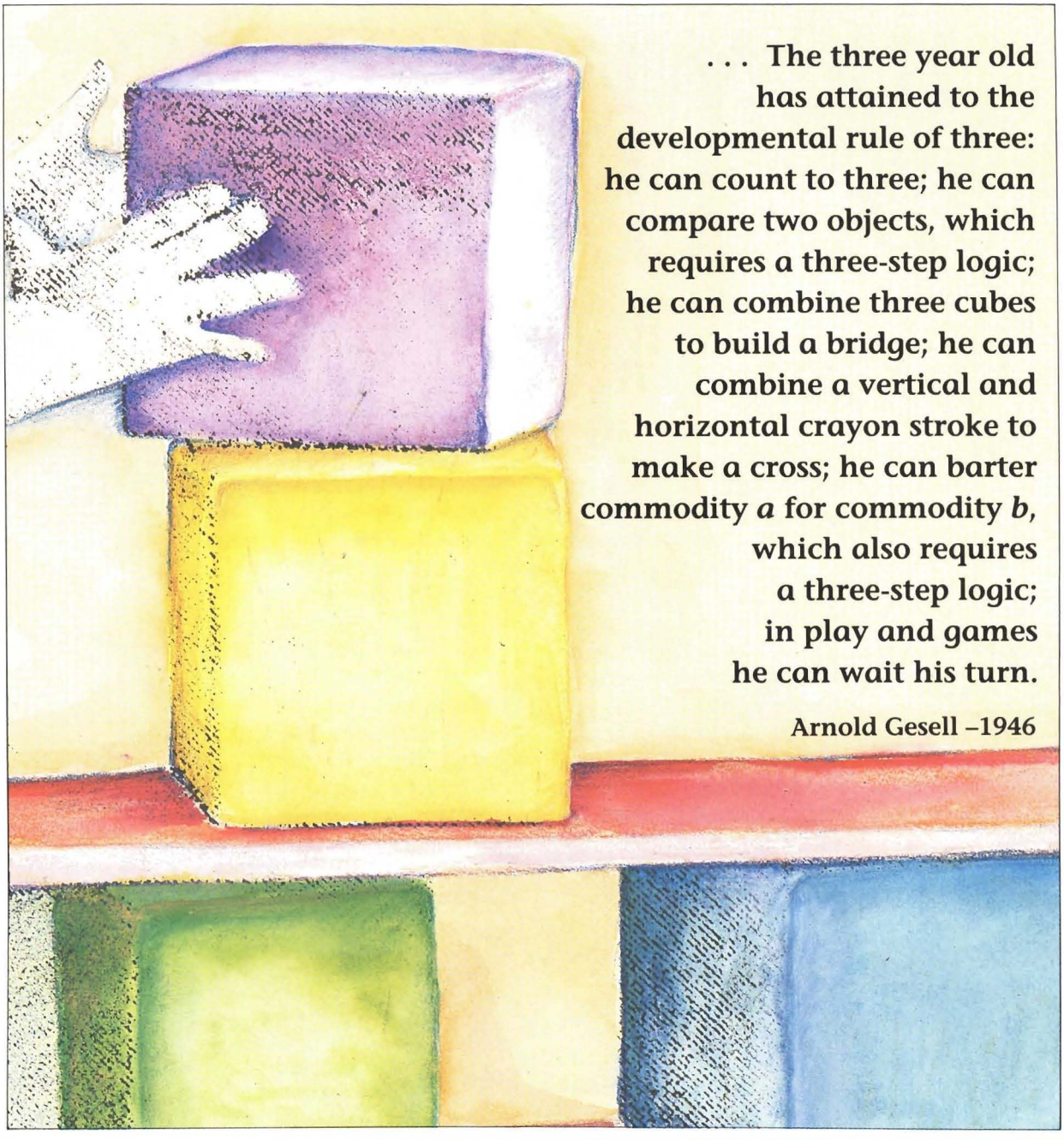
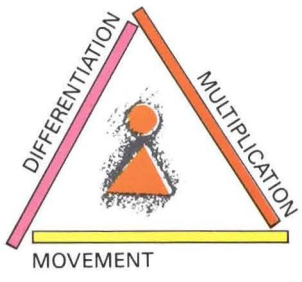


. . . The three year old has attained to the developmental rule of three: he can count to three; he can compare two objects, which requires a three-step logic; he can combine three cubes to build a bridge; he can combine a vertical and horizontal crayon stroke to make a cross; he can barter commodity *a* for commodity *b*, which also requires a three-step logic; in play and games he can wait his turn.

Arnold Gesell –1946

THE CHILDHOOD SHOWS THE MAN AS
MORNING SHOWS THE DAY.

–John Milton



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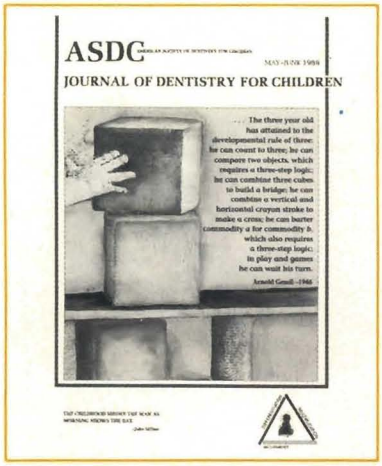

The three-year old has captured the power of judging and choosing between two rival alternatives. In fact, he likes to make a choice within the realm of his experience.

Art and design by Sharlene Nowak-Stellmach.

CLINIC

For the busy reader

The ingestion of fluoride dentifrice by young children—page 177

Through the fluoridation of drinking water, fluorides are becoming an increasing part of the human environment in industrialized countries. Fluoridated toothpastes are widely used in the United States and Canada. The younger a subject is, the greater proportion of toothpaste he or she tends to swallow.

Requests for reprints should be directed to Dr. Paul L. Simard, Ecole de Medecine Dentaire, Universite Laval, Sainte-Foy, Quebec, G1K 7P4 Canada.

Radiographic evaluation of pulpal therapy for primary anterior teeth—page 182

A total of 144 anterior primary incisors with formocresol pulpotomies or pulpectomies comprised the study sample. Although the former had a moderately high success rate, those incisors treated with the latter procedure had a better prognosis. It may be the preferred treatment when the extent of pulpal involvement cannot be determined.

Requests for reprints should be directed to Dr. Catherine M. Flaitz, Department of Growth and Development, University of Colorado Health Sciences Center, 4200 E. 9th Avenue, Box C284, Denver, CO 80262.

The effect of etch-time on the bond strength of a sealant and on the etch-pattern in primary and permanent enamel: an evaluation—page 186

This study was undertaken to establish laboratory evidence of minimum etch-time for primary enamel, for effective retention of occlusal sealants. The effect on enamel of contamination by oral fluid for different exposure times was also evaluated. Here it is shown that a short etch-time of 15 sec is satisfactory for primary enamel, and is also sufficient to produce the required etch-pattern for the strong binding of sealants.

Requests for reprints should be directed to Dr. Shobha Tandon, 151, K.M.C. Quarters, Manipal-576 119, South Kanara, India.

The relationship of parental dental anxiety and child's caries- status—page 191

The objective was to determine whether parental dental anxiety is associated with the caries status of their children. A higher level of dental anxiety was found among caries-active children, probably due to their more negative experiences in treatment. Also, fathers from the lower socioeconomic group who had a high level of dental anxiety had children with lower df-scores.

Requests for reprints should be directed to Dr. Satu Lahti, Dept. of Community Dentistry, University of Kuopio, P.O. Box 6, SF-70211 Kuopio, Finland.

The clinical diagnosis of occlusal caries: a problem—page 196

This study attempted to evaluate the clinical procedures used to diagnose occlusal caries and also considered the availability of other diagnostic methods, either more reliable than or supplementary to the examination with mirror, probe, and light.

Requests for reprints should be directed to Dr. Karin L. Weerheijm, Vrije Universiteit de Boelelaan 1115, P.O. Box 7161, 1007 MC Amsterdam, The Netherlands.

Residual contamination of toothbrushes by microorganisms—page 201

Procedures for maintaining the cleanliness of oral cleaning instruments have been discussed infrequently. *S. mutans* and pathogenic microorganisms can be transferred readily when a toothbrush is used, increasing the risk of dental caries and infectious diseases. It is suggested that sterilization equipment or specific detergents be used.

Requests for reprints should be directed to Dr. Katsuyuki Kozai, Department of Pedodontics, Hiroshima University School of Dentistry, 2-3, Kasumi 1-chome Minami-ku, Hiroshima 734, Japan.

Relationships between def, demographic and behavioral variables among multiracial preschool children—page 205

In general, the data produced in this study suggest that children's dental health is related to certain practices begun during the infant and preschool years. Specific interventions (e.g., early weaning, parent-assisted toothcleaning, and diets high in milk and low in sugar) will decrease the incidence of caries in children.

Requests for reprints should be directed to Ms. Mary E. Skarie, Nursing Supervisor, Fort Worth Public Health Department, 1800 University Drive, Fort Worth, TX 76107.

Special pediatric population groups and their use of dental services—page 211

With special training and experience, many pediatric dentists are at the forefront in the care of the special population groups: the developmentally disabled; the chronically and the acutely ill; the hospitalized patient; the high-risk patient; and a variety of others with special needs.

Requests for reprints should be addressed to Dr. H. Barry Waldman, Professor and Chairman, Department of Dental Health, School of Dental Medicine, State University of New York at Stony Brook, Stony Brook, NY 11794-8715.

Continuing potential for pediatric dental services in nonurban areas—page 216

Recently published pediatric dental-use-pattern data (into the second half of the 1980s), based on a distribution by urban vs nonurban residents, permit a review of the proposal for pediatric dentists to increase practice activities in nonurban areas. Despite a major concentration of the population in metropolitan areas of the country, there are 13.4 million children (between two and seventeen years of age) living in nonmetropolitan areas.

Requests for reprints should be directed to Dr. H. Barry Waldman, Professor and Chairman, Department of Dental Health, School of Dental Medicine, State University of New York at Stony Brook, Stony Brook, NY 11794-8715.

Ehlers-Danlos syndrome: Historical review, report of two cases in one family and treatment needs—page 220

Easy bruising in EDS is common, and is frequently the presenting complaint. Bleeding from the gingiva following toothbrushing or dental extraction is another manifestation. There are many oral manifestations of this syndrome.

Requests for reprints should be directed to Dr. R. Richard Welbury, Dept. Child Dental Health, Dental School, Framlington Place, Newcastle upon Tyne, NE2 4BW England.

Dental considerations in the treatment of Wiskott-Aldrich syndrome: report of case—page 225

This disease is characterized by cutaneous eczema (usually beginning on the face), thrombocytopenic purpura, and an increased susceptibility to infection due to an immunologic defect. Oral manifestations include gingival bleeding and palatal petechiae. Hyperplastic gingiva may now be expected as a complication of cyclosporine A therapy.

Requests for reprints should be directed to Dr. Robert A. Boraz, Associate Professor of Surgery and Pediatrics, University of Kansas Medical Center, 39th and Rainbow Blvd., Kansas City, KS 66103.

Recent advances in the management of lactose intolerance—page 228

This article provides an overview of the recent research findings relating to the dietary management of lactose intolerance, a concern for the majority of the world's population. Persons who have symptoms following the consumption of milk should consult with their physician. Symptoms may be eliminated or reduced with good dietary management.

Reprints are not available.

The ingestion of fluoride dentifrice by young children

Clinic

Paul L. Simard, DDS, DPH
Diana Lachapelle, HD, MS
Luc Trahan, PhD
Herminé Naccache, MS
Marie Demers, MS
Jean-Marc Brodeur, DDS, PhD

Fluorides are becoming an increasing part of the human environment in industrialized countries. The phenomenon may largely be ascribed to fluoridated drinking water which, aside from directly supplying a significant amount of fluoride, introduces the substance into the food chain. Fluorides also have taken their place among preventive means used by the general public and/or dentists and dental hygienists in the form of dietary supplements, topical application, mouthwashes, toothpastes, etc. General usage of fluorides has raised the fear of fluorosis, especially since Leverett observed that the prevalence of this disease had increased in a fluoridated community.[1] From his viewpoint, this phenomenon may be largely imputable to the ingestion of fluoride from toothpastes. It is common knowledge that fluoridated toothpastes are experiencing widespread popularity and even occupy more than 90 percent of the U.S. market and probably nearly as much in Canada.[2] Quebec-based research demonstrated that 90 percent of

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children in 5th and 6th grades who participated in a project (N = 840) used fluoridated toothpastes at home.[3] Furthermore, according to Heifetz and Horowitz, studies show that a large proportion of children begin using toothpastes while they are still very young, often without the assistance of parents.[4] The same authors state that "it is possible that some young children who brush twice a day, repeatedly ingest as much as two-thirds mg F daily". The small number of studies carried out on the ingestion of dentifrice by young children, and especially of fluoride, are, however, silent on this issue.[5-8] The present pilot study was designed, therefore, to determine:

- ☐ The proportion of dentifrice ingested as compared with the quantity of dentifrice actually used by young children.
- ☐ The quantity of fluoride ingested during a toothbrushing.
- ☐ The influence of mouthrinsing after brushing on the quantity of F ingested.

METHODS AND MATERIALS

The experiment was conducted with twenty-three children at the Laval University day-care center located in a nonfluoridated community (Ste-Foy). First, a questionnaire was sent to parents (35) to collect information on children's toothbrushing habits, in order to reproduce their familiar environment as faithfully as possible during the toothbrushing session. The emphasis was placed on the frequency of brushings, the use of (fluoride) dentifrice, the quantity of dentifrice used during a brushing, the identity of the person putting the toothpaste on the brush and doing the brushing (parent or child) and the mouthrinsing habit.

At the day-care center, toothbrushing was done with a fluoride dentifrice in gel, 0.24 percent NaF, under the supervision of a dental hygienist and a dental assistant. Depending on answers to the questionnaire, either the child or the hygienist put the toothpaste on the brush and brushing was performed by the child or the hygienist; finally, depending on habit, the child would or would not rinse his mouth. On average a brushing lasted five minutes. For each subject, a tube of dentifrice was weighed before and after use, indicating the weight of gel used. During toothbrushing all expectorated saliva, liquids and gel were collected in a one liter plastic beaker; afterwards the toothbrush and the wooden spatula used to collect this material were added to the beaker. The toothbrush and the spatula were rinsed with deionized water and the total volume was brought up to 50 ml. The toothbrush and the spatula were removed; 50 ml of TISAB buffer were added and the suspension was homogenized. In order to plot the standard curve, analytic quality NaF was used and all reagents used in the process were free of fluoride. Positive and negative controls were run. The dosage was made according to the total volume of each of the liquids collected. Based on the concentrations obtained, the rejected quantities of fluoride were calculated according to established equivalence formulae. Then the quantities of fluoride ingested were derived by determining the difference between the quantity used and the quantity rejected.

RESULTS

The questionnaire

Twenty-three out of thirty-five parents answered the questionnaire and allowed their children to participate in the study (9 girls and 14 boys). According to answers given in the questionnaire, the children's ages ranged from two to five: three two-year olds, two three-year olds, nine four-year olds and nine five-year olds. Nearly all of the children brushed their teeth by themselves (21 of 23); except one, all of them used a child-size toothbrush. The majority (71.4 percent) performed two brushings daily; 23.8 percent brushed three times daily; and 4.8 percent, only once daily. All parents stated that this practice was habitual (one did not answer); they also answered that their children used toothpaste and with only one exception, it was fluoridated. Most parents (77.3 percent) put the toothpaste on the brush themselves; consequently, few children (22.7 percent) did this operation by themselves. As for the quantity of toothpaste spread on the toothbrush, in 40.9 percent of the cases it covered a third or less; in 50 percent of the cases, more than a third, but less than two thirds; and lastly, in 9.1 percent of the cases, two thirds and more (one subject did not answer). Lastly, 78 percent of the children rinsed their mouths after brushing.

The experiment

Table 1 shows the quantity of dentifrice used and ingested according to age. On average, children used 0.662g of dentifrice and ingested 0.299g; utilization and ingestion were higher among the four-year-old children. The proportion of the quantity of dentifrice ingested as compared with that used appears in Figure 1. This quantity decreased with age, passing from 59.4 percent

Table 1 ☐ Quantity (g) of dentifrice used and ingested during a toothbrushing session according to age.

Age (years)	Children (number)	Dentifrice used (g) (S.D.)	Dentifrice ingested (g) (S.D.)
2-3	5	0.464 ± 0.19	0.278 ± 0.13
4	9	0.783 ± 0.28	0.390 ± 0.25
5	9	0.651 ± 0.34	0.221 ± 0.12
All	23	0.662 ± 0.30	0.299 ± 0.19

Table 2 ☐ Quantity (mg) of fluoride ingested during a toothbrushing session according to age.

Age (years)	F ingested (mg) (S.D.)
2-3	0.304 ± 0.15
4	0.429 ± 0.27
5	0.243 ± 0.13
All	0.329 ± 0.20

Table 3 ☐ Daily quantity of ingested fluoride in excess of the recommended dosage according to age.

Age (years)	Children (number)	F in excess (mg)
2	2	0.22
		0.34
4	3	0.40
		0.46
		0.76
5	2	0.17
		0.26

among the two and three-year olds, to 48.1 percent for the four- year olds, and 34.0 percent with five-year olds. The difference is statistically significant between two- and three-year-old and five-year-old children ($t = 2.87$ and $p<0.01$).

Table 2 shows the quantity of fluoride ingested per brushing; the average is 0.33 mg. Five-year olds were the ones who ingested the least amount. Furthermore, considering the frequency of brushing, as determined from the answers to the questionnaire for each child, the daily quantity of ingested fluoride was determined. On average, a child ingested 0.73 mg (S.D. = 0.46). A third of the children had an intake in excess of the recommended daily amount of fluoride, however, varying from 0.17 mg to 0.76 mg (Table 3). Figure 2 shows that children who did not rinse their mouths, ingested 0.49 mg of F (S.D. = 0.22) at each brushing, as compared with 0.28 mg (S.D. = 0.19) for those who rinsed their mouths ($p<.05$).

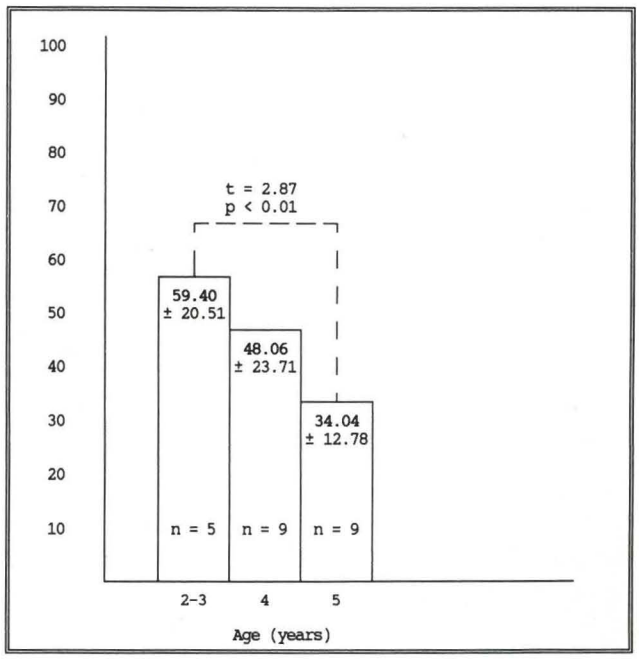

Figure 1: Ingested portion of the dentifrice used according to age.

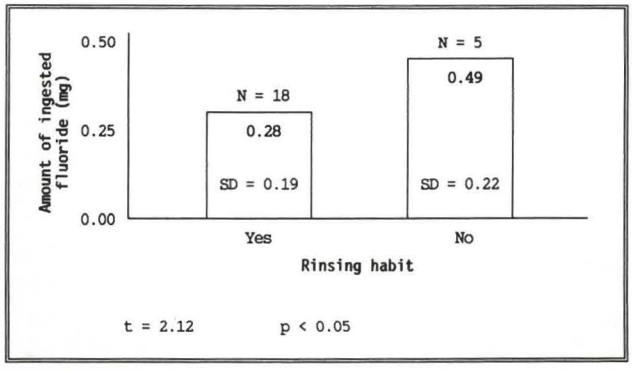

Figure 2: Amount of ingested fluoride (mg) per brushing according to the rinsing habit.

DISCUSSION

Methodology

The method used proved to be easy to apply due to the choice of a dentifrice in gel, 0.24 percent NaF, which allowed a direct determination of fluoride by means of a selective electrode. Although the method has its drawbacks, it was more efficient than say, the measurement of fluoride in urine used by Hargreaves *et al* and Forsman and Ericsson or that of fluoride in fecal matter by Naylor *et al.*[7,9,10] In addition to difficulties inherent in collecting urine and feces from young children, these methods have the disadvantage of not being able to provide exclusive identification of fluoride originating from the dentifrice. Of course, the present method tends to over-

estimate the quantity of dentifrice ingested since any loss is considered as being ingested. Because of close supervision exercised during brushing and special attention paid to the recovery of dentifrice not put in the mouth or which was expectorated, however, overestimation was held to a minimum.

The questionnaire proved to be an appropriate instrument for reproducing children's brushing habits during the experiment, namely for the quantity of dentifrice put on the brush and the rinsing at the end of the brushing. Identification of the brand of dentifrice used at home presented certain difficulties. In a later study, special attention should be paid to this question since fluoride concentration is not uniform from one brand to another. The most efficient way to know the name of the dentifrice used would probably be to ask the parents outright.

Since results from more extensive research could be used to specify the contribution of fluoride dentifrice to fluorosis, the age of children included in the study becomes an appropriate question. On the one hand, Heifetz and Horowitz agree that the children six years of age and older, the amount and frequency of use of fluoride dentifrice pose neither acute nor chronic risks to health or appearance.[4] Yet on the other, since teeth that are likely to be subject to esthetic problems caused by fluorosis are anterior teeth and premolars and their enamel formation begins at about three to four months at the earliest and ends at six to seven years at the latest, it seems logical to perform the study on children of seven years of age and less.[11] This view is reinforced on the basis of works by Larsen *et al*, as well as Richards *et al*, leading Szpunar and Burt to state that there are now suggestions that fluorosis may still occur in the late stages of enamel maturation.[12-14]

Since Hargreaves *et al*, as well as Baxter, found that most subjects were not consistent in the amount of dentifrice ingested, within the framework of a vaster study, it would be a valid objective to resort to more than just one toothbrushing.[5,7]

Results

The study showed that the younger a subject is, the larger the proportion of toothpaste he tended to swallow. Barnhart *et al* made a similar observation with subjects classified into four age-groups, i.e. two- to four-year-olds, five- to seven-year-olds, eleven- to thirteen-year-olds and twenty- to thirty-five-year- olds.[6] Even though Ericsson *et al*, as well as Baxter, did not establish the relationship of dentifrice ingested/dentifrice used, they observed that the younger the subject was, the more dentifrice he swallowed.[5,8] Whitford *et al* attributed this greater ingestion of dentifrice among young children to an inadequate control of their swallowing reflex.[15] So in order to reduce dentifrice ingestion, it is not as important to recommend that young children do not swallow toothpaste as to see that the quantities of dentifrice put on their brushes be smaller.

The quantity of fluoride ingested at each brushing represents a significant amount. By considering the number of daily brushings and the optimal fluoride quantity recommended for children, depending on age, by the American Dental Association, it was possible to determine that by toothbrushing alone, a third of the children received an amount of fluoride in excess of the recommended dosage.[16] This surplus is not negligible since it involves 0.17 to 0.76 mg. These data indicated that the amount of fluoride contributed by fluoride dentifrices alone could play an important role in the occurrence of fluorosis since the safety margin is small. Recent research supports this assertion. In fact, even though Szpunar and Burt, in a study conducted on school children residing in four different communities with various concentrations of F in community water supplies, did not find cases of severe fluorosis, they nonetheless detected a prevalence of very mild fluorosis of 36.3 percent for all children.[14] Furthermore, Heifetz *et al* noted that when the water-fluoride level was 2 X optimal, 7.6 percent of the labial surfaces of maxillary anterior teeth of thirteen to fifteen-year-old children showed forms of severe fluorosis.[17] All such data indicate that in the future, increasing caution must be exercised in prescribing or using fluorides with young children.

As shown in Figure 2, to a statistically significant extent children who do not rinse their mouths after brushing ingest more toothpaste. This aspect of the question has not been covered previously, except by Baxter, who had made a similar observation.[5] The habit of mouthrinsing after brushing, which is not regularly included in dental hygiene advice given to parents, could prove to be quite instrumental in reducing the ingestion of dentifrice.

To summarize, the data suggest that a) the younger the children, the more likely they are to swallow a greater proportion of dentifrice; b) for an important percentage of young children, the use of a fluoride dentifrice provides per se a daily quantity of fluoride above the recommended dosage; c) young children who rinse their mouths after brushing, ingest less dentifrice. Results obtained from this pilot study support the need for a study in greater depth on the same subject and that

would be based on a method analogous to the one presently used.

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This investigation was supported by Le Fonds Emile-Beaulieu.

CORRECT USE OF A PULP TESTER

The threshold response to the electric pulp tester varies depending on the tooth type, condition of incisal enamel, and electrode placement site.

Different types of teeth have different response levels. As a whole, anterior maxillary teeth have a higher response threshold than anterior mandibular teeth.

The condition of the tooth enamel also determines the threshold response. Abrasion or attrition of incisal enamel results in a decrease in the response threshold. Furthermore, the application of an electrode to exposed dentin may cause an unpleasant sensation in the tooth.

Different electrode placement sites are associated with varying response thresholds. The response threshold is lowest at the incisal tooth edge and increases as the electrode is moved closer to the cervical region of the tooth. The placement of the electrode on the incisal edge of the tooth is less likely to result in the activation of the periodontium nerves, thereby minimizing the risk of a false-positive response to the electric pulp tester. If exposed dentin is present at the incisal edge, however, the electrode should be placed at the incisal-third site of the labial surface.

Finally, if the doctor's rubber gloves inhibit the electrical current from the pulp tester, the patient should touch the end of the probe tip handle after the tester has been positioned.

I.B. Bender *et al*; The optimum placement-site of the electrode in electric pulp testing of the 12 anterior teeth. J Am Dent Assoc, 118:305-310, March, 1989,

Radiographic evaluation of pulpal therapy for primary anterior teeth

Catherine M. Flaitz, DDS, MS
Elizabeth S. Barr, DMD
M. John Hicks, DDS, MS, PhD, MD

Most clinical studies on the long-term success-rate of formocresol pulpal therapy for primary teeth are limited to molars.[1-5] Studies show that the clinical success of the pulpotomy procedure is approximately 90 percent, while the pulpectomy procedure averages 80 percent.[2-7] In contrast, there is little published information about the prognosis of pulpal treatment for primary anterior teeth, except for specific case reports and descriptive references.[7-9]

The dentist frequently must decide how to treat anterior teeth that are pulpally-involved because of nursing bottle caries or trauma. The mode of treatment is controversial. The purpose of this retrospective clinical study was to evaluate the success of anterior pulpotomies and pulpectomies, performed in private practice, by examining pretreatment and posttreatment periapical radiographs for pathological changes.

METHODS AND MATERIALS

A total of 144 anterior primary incisors with formocresol pulpotomies or pulpectomies performed in a private pediatric dental practice were selected for the study. The treatment groups included fifty-seven pulpotomy and eighty-seven pulpectomy procedures. Only those teeth that had pulpal therapy completed at least twelve months before the study, with pretreatment and posttreatment radiographs available, were included.

The indications for use of the vital pulpotomy technique are well known. The indications for the pulpectomy procedure are more subjective and involve either vital or necrotic pulpal tissue that has spread beyond the coronal chamber. Teeth with signs and symptoms such as: prolonged pain, presence of pathologic sinus or parulis, limited mobility, hemorrhagic or necrotic pulpal tissue, minimal pathologic root resorption, and radiographic evidence of minimal bony degeneration were treated with the pulpectomy procedure. This procedure was not performed on incisors that were nonrestorable or when excessive resorption of root and/or bony support was diagnosed.[9]

All teeth to be restored were anesthetized and isolated by rubber dam. With the pulpotomy procedure, the coronal pulpal tissue was amputated. Bleeding was controlled by applying light pressure with a dry cotton pellet without a medicament. The usual five-minute application of formocresol before placement of the treatment paste was not made. The treatment paste consisting of a mixture of zinc oxide paste with equal parts of eugenol and formocresol was placed in the pulp chamber.

When the pulpectomy procedure was used, the pulp was removed with a series of endodontic files at a pre-

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determined length, to about 1-2 mm short of the apex. The canal was irrigated with water and then filled with the treatment paste, using the last file to gently condense the material.

All the treated teeth received a final restoration. Following the placement of the restoration, a postoperative radiograph was obtained. At intervals of three months to a year, additional posttreatment films were taken to evaluate the tooth.

Preoperative and posttreatment radiographs were read by three pediatric dentists concomitantly. The periapical radiographs were read for the following:

- ☐ Apical radiolucency.
- ☐ The integrity of the lamina dura.
- ☐ Evidence of pathologic root resorption, including internal and external.
- ☐ Acceptability of root canal filling.
- ☐ Incidence of calcific metamorphosis.
- ☐ Resorption of treatment paste.

When a tooth was missing on a radiograph, except in cases of normal exfoliation, the patient's record was reviewed for the reason for extraction. Reasons for extractions were classified as *pulpal therapy failure*, *extraction for orthodontic purposes*, or *retained treatment paste*. After reviewing the most recent postoperative film, the examiners rated the theory as being *successful*, *questionable*, or a *failure*. The treatment outcome was judged to be successful under three conditions:

- ☐ When the tooth had been maintained without radiographic evidence of pathologic changes.
- ☐ When there was evidence of a previously diagnosed radiolucency, but the bony lesion had decreased in size.
- ☐ When loss of integrity of the lamina dura shown in the first radiograph had not resolved, but no other pathoses were present.

A radiographic failure was diagnosed, when there was evidence of a new or enlarging periapical radiolucency. Questionable treatment outcomes were diagnosed, when there was loss of integrity of the lamina dura that had not been observed on the initial radiograph.

RESULTS

Pretreatment and posttreatment radiographs from 144 primary incisors that had received formocresol pulpal therapy were evaluated. A review of the clinical records indicated that 84.2 percent of the incisors in the pulpotomy group were treated because of caries and 15.8 percent because of trauma. In contrast, 28.7 percent of the anterior teeth in the pulpectomy group were treated because of caries, compared to 71.3 percent because of trauma. The mean length of treatment-time for both groups was thirty-seven months, with a range of twelve to sixty-five months. At the time of therapy, the majority of the incisors had undergone complete root development, with an equal percentage in both groups. Restorations had been previously placed in approximately 5 percent of the teeth in the pulpotomy group and 20 percent of the teeth in the pulpectomy group (Table 1).

Table 1 ☐ Baseline data for anterior pulpal therapy

	Pulpotomy	Pulpectomy
Number of cases	57	87
Reason for treatment		
Caries	84.2%	28.7%
Trauma	15.8%	71.3%
Mean length of treatment time	36.9 months	37.4 months
Complete root development	87.7%	87.4%
Restoration before pulpal therapy	5.3%	19.5%

Table 2 ☐ Radiographic findings for anterior pulpotomies in percent.

	Pretreatment	Posttreatment
Radiolucency	22.8	31.6
Loss of integrity of the lamina dura	31.6	38.6
Pathologic root resorption	12.3	35.0
Internal	5.3	17.5
External	7.0	17.5
Calcific metamorphosis	0	42.1

The radiographic findings for the two treatment groups differed, when comparing the preoperative and posttreatment films. When reviewing the results from the pulpotomy group, it was found that 22.8 percent of the preoperative films showed radiolucencies in the periapical regions versus 31.6 percent of the posttreatment films. Of the original radiolucencies, a third of the lesions had resolved in postoperative radiographs, suggesting a misdiagnosis of the initial periapical films. Loss of integrity of the lamina dura was noted in 31.6 percent of the preoperative and 38.6 percent of the postoperative radiographs. This did not include those teeth in the postoperative group that were undergoing normal root resorption at the apices. Pathologic root resorption was observed in 12.3 percent of the preoperative and 35 percent of the posttreatment radiographs. This pathologic process was evenly divided between external and internal root resorption. Calcific metamorphosis was a common posttreatment finding, accounting for 42.1 percent of the pulpotomized incisors (Table 2).

Table 3 ☐ Radiographic findings for anterior pulpectomies in percent.

	Pretreatment	Posttreatment
Radiolucency	44.8	26.4
Loss of integrity of the lamina dura	78.2	49.4
Pathologic root resorption	40.2	22.9
Internal	1.1	1.1
External	39.1	21.8
Calcific metamorphosis	0	2.3
Treatment paste resorption	—	71.3

Table 4 ☐ Tooth loss following anterior pulpal therapy in percent.

	Treatment	
Reason	Pulpotomy	Pulpectomy
Extraction	31.6	32.2
Orthodontic reason	8.9	20.7
Retained paste	0	9.2
Failure	22.7	2.3
Exfoliation	8.8	28.8

Table 5 ☐ Radiographic findings for anterior pulpotomies in percent.

Prognosis	Pulpotomy	Pulpectomy
Successful	68.5	84.0
Questionable	3.5	2.3
Failure	28.0	12.6

Pretreatment radiographs showed more pathoses in the pulpectomy than in the pulpotomy group. Periapical radiolucencies were observed in 44.8 percent of the preoperative and 26.5 percent of the posttreatment films. Approximately 75 percent of these radiolucencies showed a decrease in size. There was loss of integrity of the lamina dura in 78.2 percent of the preoperative films versus 49.4 percent of the posttreatment radiographs. Lack of integrity of the lamina dura was most frequently noted at the root apices. Pathologic root resorption was diagnosed in 40.2 percent of the preoperative films, but decreased to 22.9 percent for postoperative findings. Calcific metamorphosis occurred in 2.3 percent of the cases where canals were underfilled (Table 3).

The quality of the root canal filling was judged to be acceptable in 89.6 percent of the immediate postoperative films. Nine percent of the treated teeth required, however, curettage of the treatment paste because of extrusion periapically of more than 2 mm of the medicament. In 28.7 percent of the treated teeth, incomplete resorption of paste was observed in the last available film.

The incidence of tooth loss was classified in two categories: extraction and exfoliation (Table 4). Approximately 32 percent of the incisors had to be extracted, from both of the treatment groups. The reasons for extraction differed, however, between the two groups. Pulpotomized incisors were extracted, due to failure in 22.7 percent of the cases; while pulpectomized incisors were extracted, due to incomplete resorption of paste or failure in 11.5 percent of the cases. The remaining teeth to be extracted, in both groups, were extracted for orthodontic reasons. At the completion of the study, 8.8 percent of the pulpotomized incisors and 28.8 percent of the pulpectomized incisors were exfoliated. The majority of the teeth were exfoliated close to the appropriate time, when compared to the rest of the developing dentition. There was a tendency for the treated incisors, however, to have an accelerated eruption pattern of not more than six months. Accurate evaluation was not always possible with the antimere tooth, because similar treatment was performed on both incisors.

The prognoses for both pulpotomized and pulpectomized incisors were favorable in the majority of the treated teeth (Table 5). Based on the most recent radiographs, treatment was successful in 68.5 percent of the teeth in the pulpotomy group and in 84 percent of the teeth in the pulpectomy group. Questionable radiographic evidence, requiring frequent monitoring, occurred in 3.5 percent of the pulpotomized incisors and 2.3 percent of the pulpectomized incisors. Failures were diagnosed in 28 percent of the teeth in the pulpotomy group and 12.6 percent of the teeth in the pulpectomy group.

DISCUSSION

Pulpal therapy is frequently applied to primary teeth, to prevent their premature loss and its effect on the developing dentition. Although pulp treatment has been universally accepted for posterior teeth, its use for anterior teeth is controversial. The opinion among many dentists who treat young children is that the prognosis for treated anterior teeth is not as good as for treated posterior teeth. There is no recorded evidence, however, to support this observation.

In this study, successfully treated teeth, based upon radiographic criteria, included incisors in the successful and questionable categories. The incisors in the questionable group were considered to be successfully treated, but required more careful monitoring. The success-rate of pulpotomized incisors was 72 percent when evaluated radiographically, a rate less favorable than that for primary molars, which is over 90 percent.[2-4] Even when this investigation was compared to the study in which formocresol was not applied, a much higher success-rate of 93.8 percent was observed for the posterior teeth.[4]

The prognosis was higher in the pulpectomy group, with 86.3 percent of the treated incisors judged to be successful or questionable. This is slightly better than the findings for pulpectomized molars, which ranged from 80.5 percent to 82.3 percent.[5,6] Of particular interest in this group was the fact that, although the anterior teeth showed more evidence of pathosis on the preoperative radiographs, the success-rate was higher than for the pulpotomized teeth. This difference in the prognosis of the two treatment groups was not statistically

analyzed, because they differed markedly in their initial diagnoses and radiographic findings.

There appear to be two explanations for the difference in the success-rates of these treated teeth. Misdiagnosis is an important consideration, when interpreting radiographic findings in the incisal region, because of the close proximity of the developing tooth bud and its follicle. Subtle pathologic changes, evidence of a nonvital pulp, may be obscured by the superimposition of adjoining anatomical entities.

Another reason for failure in the pulpotomy group may be the result of subsequent trauma to these treated teeth. It is estimated that up to a third of the children younger than seven years of age will traumatize their primary incisors.[10-11] The residual pulpal tissue in such teeth may provide a nidus for an acute inflammatory response, resulting in significant degenerative changes. By removing most of the pulpal tissue, the pulpectomized incisors may have a better prognosis, when mild injuries are sustained to these teeth.

An interesting finding in the pulpotomy group was that 42 percent of treated incisors underwent calcific metamorphosis. This obliteration was reported in several studies evaluating primary molars treated by the formocresol pulpotomy technique.[3,4,12] This exaggerated odontoblastic activity is thought to be due, in part, to the chronic irritation of the pulp by formocresol. In this study, it was observed that the treatment of all but one of the incisors that underwent calcific metamorphosis was considered successful. It appears that loss of pulpal tissue from the root canal by either formation of dentin or mechanical means results in a better prognosis.

Deflection of the developing tooth bud in cases treated by formocresol pulpotomy has been described.[13] This problem was not observed in our pulpotomy group, but less than 9 percent of the incisors were exfoliated by the end of the study. In contrast, deflections of the permanent tooth bud were observed in 20 percent of the pulpectomized teeth that were extracted. In part, this finding could be explained by a higher number of traumatized teeth in this group.[14] In addition, incomplete resorption of the hard treatment paste could also be cited as a cause of this problem. Further studies are needed to evaluate the effect of these two therapies on the formation and development of the permanent incisor, when compared to primary teeth that have been extracted because of abscess formation or trauma.

CONCLUSIONS

The results from this retrospective radiographic study in a private pediatric dental practice indicate that formocresol pulpal therapy for both carious and traumatized primary incisors has a moderately high success-rate. The primary incisors that were treated, however, with the pulpectomy procedure had a better prognosis, even though they demonstrated more radiographic pathoses at the time of diagnosis. Since it is often difficult to interpret periapical radiographs in the primary incisor region for minimal pathological changes, the pulpectomy technique may be the treatment of choice, when the extent of pulpal involvement cannot be determined. Periodic radiographic observation is important after pulpal therapy, to prevent damage to the developing tooth bud when there is a failure, and to monitor the resorption of the treatment paste. The goal of pulpal therapy is to prolong the retention of primary anterior teeth in order to preserve the normal function and esthetic quality of the child's early dentition, without compromising the health of the permanent incisors.

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The effect of etch-time on the bond strength of a sealant and on the etch-pattern in primary and permanent enamel: an evaluation

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Dentistry's primary objective today is one of prevention of dental disease rather than cure. Although fluoride has occupied a pivotal position in preventive dentistry, it has had limited success with respect to occlusal caries. The relatively high incidence of occlusal caries in children is attributed to the capacity of deep pits and fissures to harbor bacterial and nutrient elements in close proximity to the dentinoenamel junction; and to the inaccessibility of this area to mechanical debridement. Although many studies have been conducted to test the bond strength of pit-and-fissure sealants to etched enamel, time of etching, and manipulative variables in permanent teeth, reports on etch-time for primary teeth are few in number and controversial.[1,2] The present study was undertaken to establish laboratory evidence of minimum etch-time for primary enamel, for effective retention of occlusal sealants. A comparative evaluation of bond-strength of pit-and-fissure sealant and etch-pattern in primary and permanent teeth at different etch-times was studied. The effect on enamel of contamination by oral fluid for different times of exposure was also evaluated.

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METHODS AND MATERIALS

Samples of primary molar teeth were collected from children eight to ten years of age (mean age nine years) and premolar teeth extracted for orthodontic purposes from children thirteen to sixteen years of age (mean age fourteen years). A total of 144 healthy noncarious, nonhypoplastic and nonfluorosed teeth was collected. They were cleaned, polished with pumice and stored in saline at room temperature. Forty-eight teeth (twenty-four permanent and twenty-four primary) were put in each of three groups (A, B, and C). Group A was used for evaluation of bond-strength of a pit-and-fissure sealant at different etch-times, using the Instron Universal Testing Machine.[3-5] Group B was used to evaluate the etch-pattern at different etch-times (15,30,60 and 120 sec.), using the Scanning Electron Microscope (SEM).[5-7] The teeth were sectioned in a buccolingual direction and the root portions cut off. The cut surfaces were polished and dried. For evaluation of the etch-pattern, the dried surfaces of the samples were treated with 37 percent phosphoric acid, applied with a cotton pellet for 15,30,60 and 120 seconds. For each time-interval, six samples were tested. The specimen was mounted on the stub of the SEM with the buccal surface exposed. A thin coating (30 μm) of pure gold was applied (ion sputtering units of 1000 volts/30 sec.) to ensure proper conduction. The mounted specimen was then placed in the vacuum

Table 1 ☐ Mean bond-strength of pit-and-fissure sealant in primary and permanent teeth.

	Etching-time											
	15 seconds Kg/cm²			30 seconds Kg/cm²			60 seconds Kg/cm²			120 seconds Kg/cm²		
Primary teeth												
Mean	66.72	±	19.75	67.42	±	19.02	66.4	±	3.50	65.76	±	10.64
Range	51.78	to	105	44.50	to	100.30	63.10	to	70.39	46.02	to	76.19
Coefficient of variation (%)	29.5			28.2			5.3			16.8		
Permanent teeth												
Mean	52.45	±	3.29	54.6	±	9.15	57.44	±	4.46	68.5	±	6.93
Range	46.11	to	55.01	45.30	to	66.34	52.59	to	61.49	62.29	to	77.66
Coefficient of variation (%)	6.2			17.3			7.7			10.2		

Table 2 ☐ Bond strength of primary and permanent teeth at different etch-times (ANOVA table).

	S.S.	d.f	M.S.S.	V.R.	P. value	Remarks
Primary teeth:						
Time differentials	16.5	3	5.5	0.025	P > .01	N.S.
Error	4388.7	20	219.4			
Total	4405.2	23				
Permanent teeth:						
Time differentials	873.22	3	291.07	7.16	P > .01	H.S.
Error	812.59	20	40.63			
Total	1685.81	23				

S.S. = Sum of squares
d.f = Degrees of freedom
M.S.S. = Mean sum of squares
V.R. = Variance ratio
N.S. = Not significant.

Table 3 ☐ The variation in the bond strength between permanent teeth and primary teeth and between different etch-times (ANOVA table).

Source	S.S.	d.f	M.S.S.	V.R. (F. value)	P. value	Remarks
Between teeth:	141.54	1	151.54	5.4	P > .05	N.S.
Time differentials	69.67	3	23.2	1.2	P > .05	N.S.
Error	77.28	3	25.76			
Total	288.49	7	41.2			

S.S. = Sum of squares
d.f = Degrees of freedom
M.S.S. = Mean sum of squares
V.R. = Variance ratio
N.S. = Not significant.

chamber of the SEM. the surface was scanned and observed on the screen at different magnifications. The topographic details of each group of samples were noted and the areas photographed. The etch patterns were analyzed as per the study of Silverstone *et al.*[8] Group C was used to evaluate the effect of salivary contaminants on the etch-patterns. These tooth samples were also etched for 60 sec. as Group B samples. The specimens were then exposed to oral fluids for different time periods (1,5,10,30 and 60 sec.), washed for 30 sec., and dried. The samples were then subjected to SEM examination, as described for Group B.

RESULTS

The mean values of bond strength for primary- and permanent-tooth enamel at different etch-times is shown in Table 1. For primary teeth, the highest mean bond strength observed was 67.42 ± 19.02 kg/cm² at an etch-time of 30 sec, while the lowest observed was 65.76 + 10.64 kg/cm² at 120 sec. On the other hand, the highest bond strength for permanent enamel was found to be 68.15 + 6.93 kg/cm² at 120 sec., while the lowest was 52.45 + 3.29 kg/cm² at 15 sec. Unlike primary teeth, a gradual increase in the bond strength with increase in etch-time was observed in permanent teeth. Applying the one-way analysis of variance (Table 2) it was observed that the variance ratio (F value) between different etch-times was statistically insignificant ($p > 0.01$) for primary teeth, but highly significant ($p < 0.01$) for permanent teeth. Applying the two-way analysis of variance (Table 3), however, it was observed that variations in bond- strength and different etch-times in primary and permanent teeth were both statistically insignificant. Statistical evaluation (student's 't' tests) of the optimum duration of etch-time and mean bond-strength are shown in Table 4. A highly significant difference ($p<0.005$) in bond strength was observed only at 60 sec. in both primary and permanent teeth.

Table 4 ☐ Difference in bond strength between primary and permanent teeth at each etch-time.

Etch-time	't' value	'P' value	Remarks
15 seconds	1.74	P > .05	NS
30 seconds	1.49	P > .05	NS
60 seconds	3.87	P < .005	HS
120 seconds	0.5	P > .05	NS

NS = Not significant
HS = Highly significant.

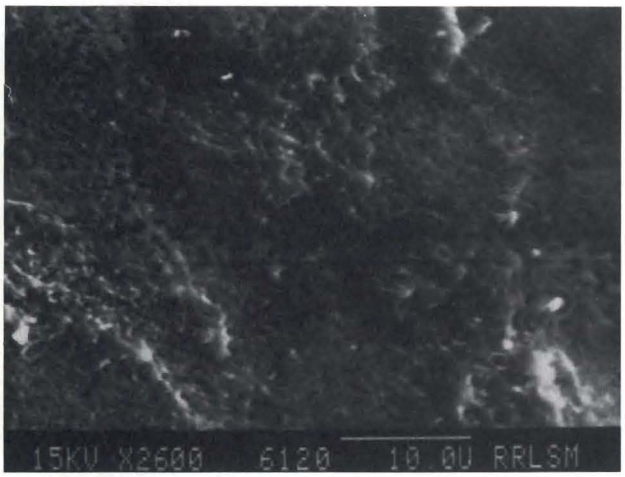

Figure 1a. Normal enamel of a primary tooth.

Figure 1b. Normal enamel of a permanent tooth.

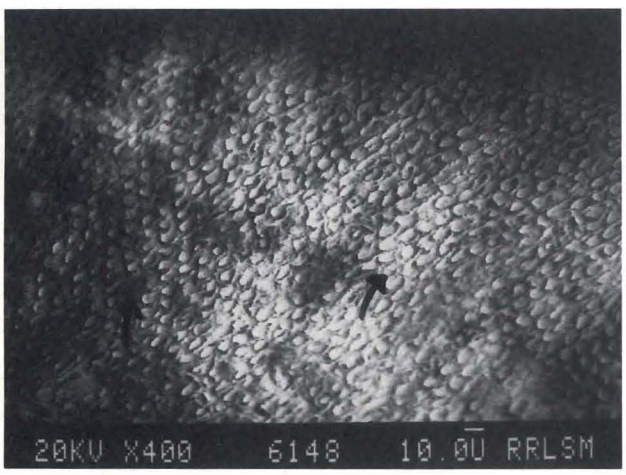

Figure 2a. Primary enamel etched for 15 seconds. Type II etch-pattern central core projecting (arrow).

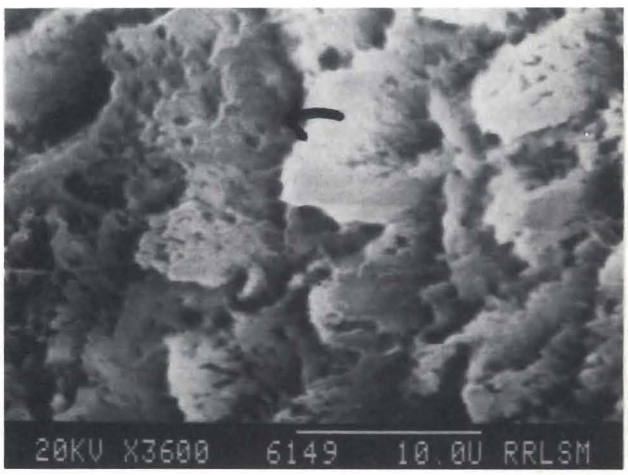

Figure 2b. Permanent enamel etched for 30 seconds. Arrow shows type II etch-pattern.

Figures 1a and 1b show the topographic details of untreated primary and permanent teeth, respectively. The crystal orientation of occlusal surface in both were found to be identical. No prismless layer was observed for primary enamel. Figures 2a, 3a and 4 depict the impressions of etched primary teeth at 15,60 and 120 sec. Figures 2b, 3b and 4 show the impressions of etched permanent teeth at 30, 60 and 120 secs. In primary enamel, a well-defined porosity indicating removal of either central or peripheral parts of a prism was observed. Pronounced surface irregularities with a few atypical rounded areas were observed after 15 sec. of etch-time (Figure 2a). Permanent enamel showed a rough etch- surface with no details of prism boundaries. All the three types of etch patterns described by Silverstone were seen (Figure 5).[8] An overall comparison to evaluate the etch-patterns at different times for primary and permanent enamel was made based on the scoring method (Table 5). For primary teeth, type I pattern predominated for 30, 60 and 120 sec. of etch-time, whereas for 15 sec. exposures, type II predominated. In the case of permanent teeth, however, the predominant pattern was type III for 15, 60 and 120 sec.; type II was more evident at 30 sec. etch-time. Contamination of the etched enamel surface with oral fluids altered the surface topography dramatically (Figures 6, 7). An adherent

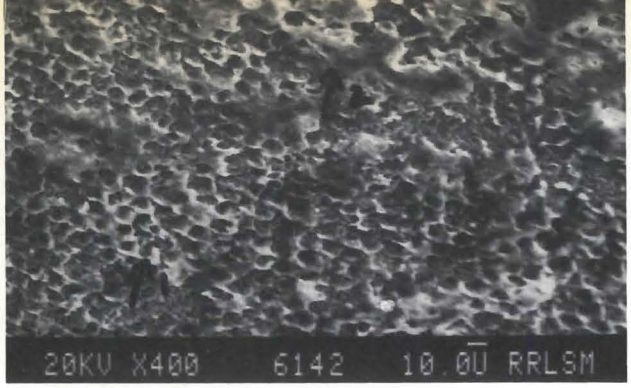

Figure 3a. Primary enamel etched for 60 seconds. Arrows (1) indicates type I etch-pattern and (2) indicates type III etch-pattern.

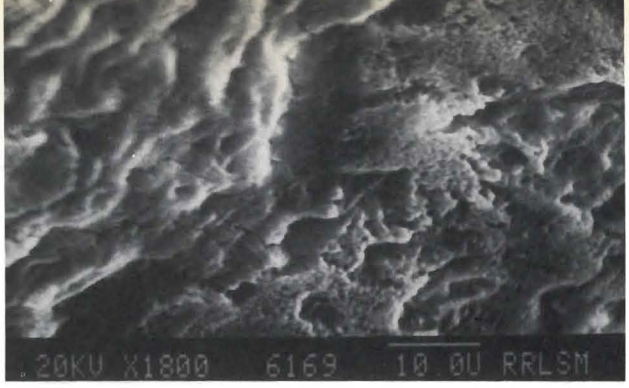

Figure 3b. Permanent enamel etched for 60 seconds.

Table 5 ☐ Etch-pattern types on primary and permanent teeth.

	Etch-pattern					
	Type I		Type II		Type III	
Etch-time	Primary	Permanent	Primary	Permanent	Primary	Permanent
15	+ +	+ +	+ + +	+	±	+ + +
30	+ + +	+ +	+ +	+ + +	±	±
60	+ + +	+ +	+	+	+ +	+ + +
120	+ + +	+	+ +	+ +	±	+ + +

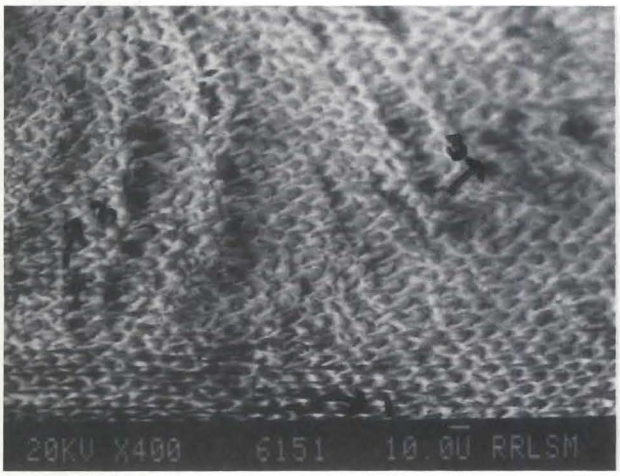

Figure 4. Primary enamel etched for 120 seconds. Arrow (1) indicates type I; arrow (2), type II; and arrow (3), type III etch-patterns.

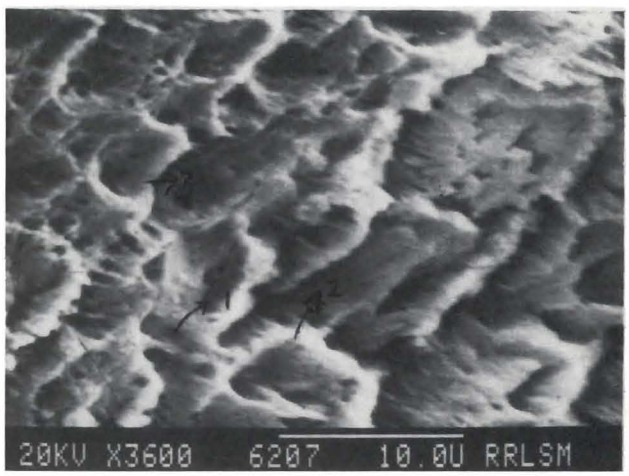

Figure 5. The three types of etch-patterns normally observed in enamel. Arrow (1), type I; (2), type II; (3), type III.

Figure 6. Etched enamel-surface exposed to oral fluids for 5 seconds.

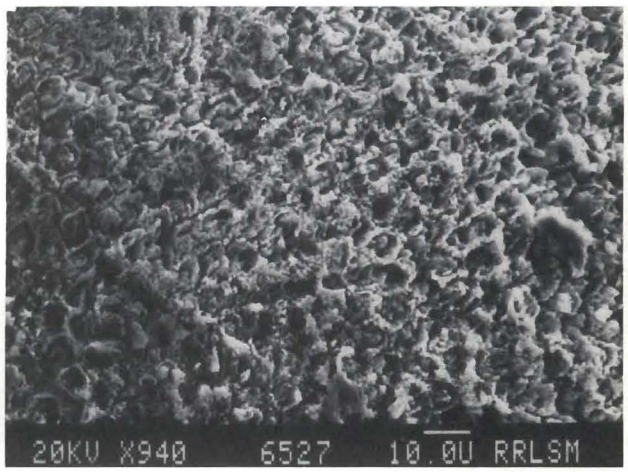

Figure 7. Etched enamel surface exposed to oral fluids for 30 seconds.

coating obscuring the underlying etched enamel pattern was observed. Even a short exposure-period of 1 sec. and washing regimen of 30 sec. showed a layer of adherent organic material over the prism structure of both primary and permanent teeth. Similar results were obtained for 5, 10, 30 and 60 sec. of exposure to oral fluids.

DISCUSSION

The results of the present *in vitro* study show that there is little significant difference in bond strength in primary and permanent teeth at different etch-times. These findings are in accordance with the results of Redford *et al*, who were of the opinion that an etch-time of 15 sec. with 37 percent phosphoric acid was adequate for primary enamel.[9] McCabe *et al* reported that the etch-time was not a critical factor in determining bond-strength.[10] Results of the paired 't' test of the present study are in agreement with this, since no significant differences in bond-strength in relation to etch-times was noted in either primary or permanent teeth. A significant variation in bond- strength at 60 sec. etch-time, however, was seen in permanent teeth, when analysis of variance was done separately. This could be due to the small number of samples analyzed.

Moghe *et al* reported the destruction of enamel and loss of pitted surface with longer etch-time.[11] Nordenwall *et al* compared the effects of 15 and 60 sec. etch-times on primary and permanent teeth.[2] No difference in effect between the different etch-times with 37 percent phosphoric acid on enamel surfaces of primary and permanent teeth was observed. Nordenwall *et al* found that 15 sec. etch-time created more retention than 60 sec. of etching.[2] Studies by Gwinnett *et al* suggest that the outermost enamel of primary teeth often shows prismless features, which influences the regularity of penetration by the resin after etching.[12] From the present study, since no statistically significant differences in bond-strength were recorded, and since no quantitative differences in the surface morphology of enamel with different etch-times were observed, it appears that the retentive character of the etched surface is similar for different etch-times. Hence it is obvious that a short etch-time of 15 sec. is satisfactory for primary enamel and is also sufficient to produce the required etch-pattern for the strong binding of sealants.

One of the major reasons for poor binding of sealants is salivary contamination of the etched enamel surface before placement of the resin. It is evident from the present study that exposure of etched enamel to oral fluid for as short a time as 1 sec. is sufficient to produce considerable alterations in the surface topography. Hence it may be necessary to repeat the etching procedure to ensure adequate bonding, should the enamel surface get contaminated with oral fluids.

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The relationship of parental dental anxiety and child's caries status

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According to behavioral scientists, dental anxiety like other fears can be viewed as a learned behavior with a complex and variable pattern; it occurs in response to internally or externally produced stimuli, and can be seen in three dimensions: cognitive, affective and behavioral.[1,2]

A variety of environmental and familial conditions can influence dental anxiety. When asking patients about their fears, Kleinknecht *et al* found that approximately 17 percent expected to experience some trauma.[3] The expectations were the results of stories told by friends and relatives, and observations on television and in cartoons.

The importance of the parental role, especially that of the mother, was shown by Johnson and Baldwin.[4] They found a highly significant relationship between the mother's response to a dental questionnaire and the behavior of her child. The anxiety level of the child was found to be directly related to the anxiety level of the mother.[5,6] Shaw observed the same relationship.[7] Demizor also found that maternal anxiety and previous dental experience influenced children negatively.[8]

Dental anxiety seems to be related also to other aspects of oral health behavior. Kirchhoff stated that fear of dentistry can restrict prophylactic measures and affect the patient's motivation toward oral care.[6] Children have also been found to imitate the oral health behavior patterns of their parents.[9]

Schuurs observed that dental anxiety affected the regularity of dental attendance.[10] He also found that a lower level of education, irregular dental attendance, and edentulousness appeared to be associated with a higher level of dental anxiety.[11]

Tuutti and Lahti found that the dental anxiety of parents correlated positively with the DMF of their children and was far more important in explaining the caries experience of the children than the children's own dental anxiety.[12] In contradiction, Brown *et al* found a negative relationship between primary dmft and dental anxiety.[13]

The association between the stress that includes dental anxiety and dental caries was reviewed by Sutton.[14] He concluded that the relationship between stress and dental caries might be explained by changes in hygienic and nutritional habits, in saliva, or in blood supply. He also mentions that fear of dental treatment is not only fear of being hurt, but also in many cases fear of losing teeth. This fear may, by initiating stress, play some part in increasing one's incidence of dental caries.[14]

The objective of this study was to determine whether parental dental anxiety is associated with the caries status of their children.

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SUBJECTS AND METHODS

Three hundred and five children, eleven through twelve years of age, from the city of Savonlinna in Eastern Finland, where a comprehensive dental-care system has existed since the 1970s, were selected as a study group. The children's caries histories were taken from the patient documents at the Savonlinna Health Center; based on these data, the study population was divided into two groups: *caries-free*, all caries-free children in this age-group (n = 111); and *caries-active*, the children whose caries-experience was most prevalent with DMF + df (n = 194), greater or at least equal to two, which is the mean of caries-incidence in this city.

In January-February 1986 the children and their parents were sent a questionnaire about their oral hygiene habits, sugar consumption, use of fluorides, education and occupation, and the level of dental anxiety (using Dental Anxiety Scale developed by Corah).[15] One hundred and sixty families responded, out of which eleven families were divorced and only mothers could be reached.

Two families were rejected because the parents were not genetic ones. In twenty-nine families, the children had either lost their last decayed/filled primary teeth and now had caries- free permanent dentitions, or had developed some caries in previously caries-free teeth. These families were excluded from the analysis so that the final number of families in the caries- free group was thirty-seven and in the caries-active group, ninety- two.

The clinical examination, df/DMF and initial caries lesions, was made, using probe, mirror, and fiber optics, by two dentists, who were calibrated before the study by having them check the same patients with full dentitions. There was disagreement concerning caries and initial caries only in two surfaces (1.6 percent of total surfaces).

Variables to measure sugar consumption were recoded into a compendium, (Figure 1), providing information on the frequency of daily sugar consumption (a higher value means more frequent consumption). Variables concerning oral hygiene habits were recoded into one variable (a low value means poor hygiene habits). Variables concerning socioeconomic status, and education and occupation were also recoded into one variable (a high value means high socioeconomic status).

Compendiums of the several groups of variables were further recoded into family variables, and correlated as shown in Table 1, describing the oral health habits and socioeconomic statuses of the families. The data were analyzed statistically by student's t- test, by contingency tables, by correlative analyses and multiple regression analyses. Levels of significance: $p < .05$ = ★, $p < .01$ = ★★, $p < = .001$ = ★★★.

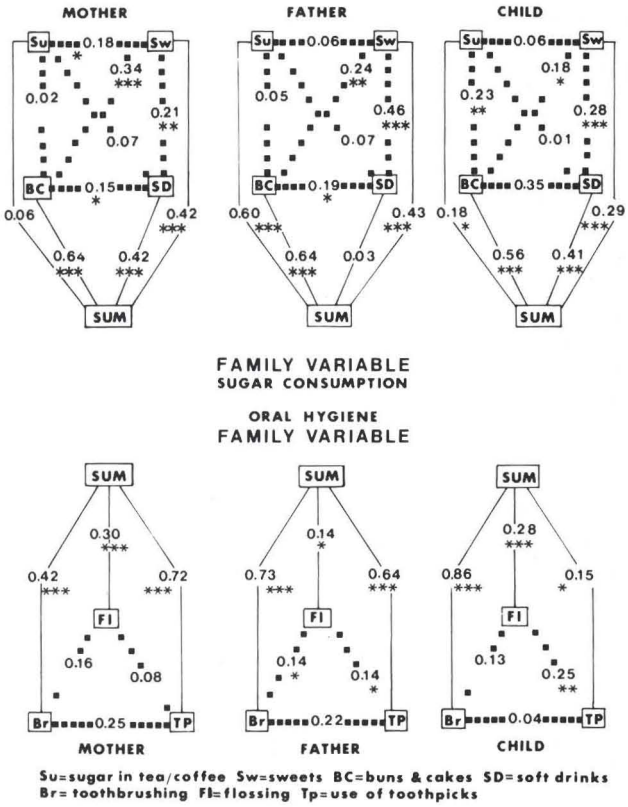

Figure 1. Compendium of variables.

Table 1 ☐ Intercorrelations among family members in sugar consumption, oral health habits, socioeconomic status and estimates on dental status of relatives.

Sugar consumption			Oral hygiene habits		
	Father	Child		Father	Child
Mother	0.36 ***	0.61 ***	Mother	0.14 *	0.24 **
Father		0.34 ***	Father		0.24 **

Dental status of relatives (estimated)			Socioeconomic status	
	Father	Child		Father
Mother	0.19 **	0.32 ***	Mother	0.41 ***
Father		0.32		

RESULTS

The level of anxiety was higher among the caries-active children than among caries-free children (★). There was no statistically significant difference between the socioeconomic status of caries-active and caries-free

groups. The df of the children was negatively correlated with the dental anxiety of the fathers ($r = 0.33$ ★★★). No significant correlation was found between the anxiety of the mothers and the df of the children; but the DMF of the mothers correlated with the df of the children ($r = 0.25$ ★★). The dental anxieties of the fathers correlated negatively with the socioeconomic status of the family ($r = 0.15$ ★) and the poor oral health habits of the family ($r = 0.17$ ★). The DMF of the mothers (Figure 2) correlated with the poor oral health habits of the family ($r = 0.17$ ★). The correlations can be seen in Table 2.

Among the families with highly anxious fathers, fathers and children used sugar more frequently than did fathers and children where the father was less anxious (children ★★, fathers ★).

When explaining the caries experience of the children by multiple regression analysis, the dental anxiety of fathers was the most important explanatory factor, 10.7 percent (★★); the socioeconomic status of the family, 5.0 percent (★★); the dental anxiety of the child, 2.9 percent (★★); and the rest of the model, including oral health habits, less than 1 percent (★★). The multiple regression analysis can be seen in Table 3.

Analysis of the data by multiple regression showed no relation between DAS of mothers and fathers and so-

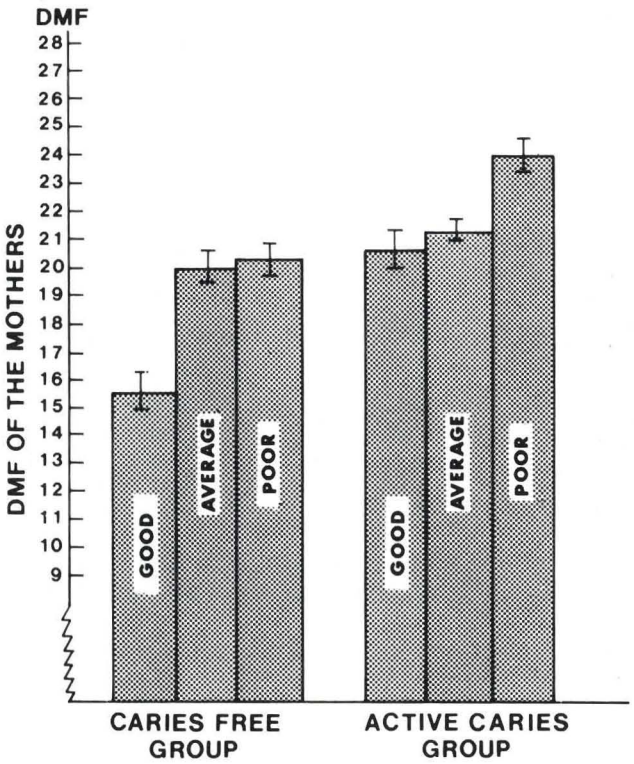

Figure 2. DMFs of the mothers of the children in the caries-free and caries-active groups (estimated). $p<.05$.

Table 2 ☐ Intercorrelations between dmf, socioeconomic status, oral health habits and dental anxiety between parents and their children.

	DMF of mother	DMF of father	Missing father	Socecon. family	Habits family	DAS of mother	DAS of father	DAS of child
DMF of child	0.25 ★★ (108)	0.15 (86)	0.07 (86)	0.17 ★ (99)	0.04 (101)	0.01 (115)	-0.33 ★★★ (103)	0.15 (115)
DMF of mother		0.00 (105)	0.08 (105)	0.14 (128)	0.17 ★ (130)	0.10 (146)	0.05 (132)	-0.07 (146)
DMF of father			0.66 ★★★ (112)	0.34 ★★★ (108)	-0.06 (111)	-0.02 (112)	0.5 (112)	-0.01 (112)
Missing father				0.05 ★★★ (108)	0.19 ★ (111)	0.36 (112)	0.17 ★ (112)	-0.09 (112)
Socecon. family					0.27 ★★ (137)	0.13 (139)	0.15 ★ (139)	0.06 (139)
Habits family						0.05 (141)	0.18 ★ (141)	0.12 (141)
DAS of mother							0.09 (143)	0.04 (158)
DAS of father								0.9 (143)

Table 3 ☐ Multiple regression analysis, explaining the caries experience of the children.

Dependent	Variable	RSQ change	R square	Significance
DMF of all children	DAS of fathers	0.107	0.107	**
	Socecon. family	0.050	0.157	**
	DAS of child	0.030	0.187	**
	Missing fathers	0.002	0.189	**
	Habits family	0.001	0.190	**
DMF of the children in low socioeconomical group	DAS of father	0.146	0.146	*
	Missing father	0.012	0.158	*
	Others			N.S.
DMF of the children in high socio-economical group	DAS of fathers	0.055	0.055	N.S.
	DAS of child	0.050	0.105	N.S.
	Missing father	0.011	0.116	N.S.
	Others			N.S.

cioeconomic status, DMF, or oral health habits.

In the lower socioeconomic group, fathers who had a low anxiety level had more caries-active children than fathers with a high anxiety level (Table 4). In the higher socioeconomic group there was no difference in caries status between the children of anxious fathers and those of nonanxious fathers. The fathers in the low socioeconomic group also had lost a greater number of teeth by extraction than those in the high socioeconomical group (means = 12.3 and 6.1 ***). In explaining the df of the children in the caries group by multiple regression analysis, the best factor was the dental anxiety of the fathers; the anxiety of the children was second. When classifying the children by socioeconomic status of the family, it was found that in the lower socioeconomic group the DAS of the fathers accounted for 14.6 percent (*) of the caries experience; while in the higher socioeconomic group, no statistically significant variables were found (Table 3).

DISCUSSION

The objective of this study was to analyze further the positive correlation between the dental anxiety of parents and the caries status of their children, as previously established by Tuutti and Lahti.[12] In this study, however, a negative correlation was discovered between the dental anxiety of fathers and the df of their children, as Brown *et al* also found.[13] When this finding was made, the previous data from Rovaniemi were analyzed more deeply, including his data on socioeconomic status. The same relationship as existed in Savonlinna, however, could not be found.

This difference can be explained as follows. Since 1977 when the data from Rovaniemi were collected there has been a tremendous decrease in caries incidence. In the Rovaniemi study of seven- to ten-year-old children, the caries incidence was measured by the use of DMF, while eight years later in Savonlinna only the df score could be used because only five DMF teeth were present. Comprehensive, preventively oriented dental-care has provided knowledge and preventive measures concerning oral health to all social groups. It is noteworthy that the lower socioeconomic group is now able to use these services free of charge, thus improving their chances of preventing dental caries in their children. Greater knowledge about oral health and dental care could help them to transfer their previous negative experiences and attitudes to positive preventive measures and thus enable their children to avoid the same negative experiences.

The results from the multiple regression analyses support the positive relationship between the dental anxiety of the fathers and the caries experience of the children. The Dental Anxiety Scale used in this study mainly measures the cognitive components of dental anxiety rather than its behavioral or affective aspects.[15] These various components were found by Tuutti not to be strongly correlated.[16] The level of dental anxiety was higher among caries-active children, probably due to their more negative treatment experiences.

Because father's dental anxiety was correlated with

Table 4 ☐ Percentage distribution of caries-free and caries-active children in relation to the dental anxiety of their fathers divided by the socioeconomic status of the family.

	Low socioeconomic status (n = 70)		High socioeconomic status (n = 69)	
	Low anxiety %	High anxiety %	Low anxiety %	High anxiety %
Caries-free children	1.3	15.7	15.1	11.6
Caries-active children	57.1	22.9	55.1	17.4
Significance	**		N.S.	

the socioeconomic status of the family, this relationship was analyzed further to determine whether socioeconomic status could explain this negative correlation. The number of extracted teeth in fathers of the low socioeconomic group differed from the number in the fathers in the high socioeconomic group. The fathers from the low socioeconomic group who had a high level of dental anxiety had children with lower df-scores. This could be due to the fact that, although the lower socioeconomic group were shown to have poorer oral health habits, fathers with more traumatic dental experiences are more interested in their children's dental health. In such cases, the information transmitted is mainly cognitive and positive attitudes toward prophylactic dental care are formed, in contradiction to Kirchhoff's finding.[5]

In comparing the multiple regression analyses explaining the df of the children in low and high socioeconomic groups, the models differed extensively. In the low socioeconomic group, 14.6 percent (★) of the child's df could be explained by the dental anxiety of the father. In the higher socioeconomic group, the whole model was not statistically significant.

Only minor differences were found in the oral health habits of the different groups. This could be due to the fact that in Savonlinna comprehensive preventive dental care has been practiced since the 1970's.

These results suggest that there is a relationship between parental dental anxiety and the caries status of their children. The mode of transference varies, however, and can result in either positive or negative attitudes toward dental care.

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The clinical diagnosis of occlusal caries: a problem

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The continued decrease in the incidence of dental caries, due primarily to the use of fluorides, affects the dentist's treatment program. Because of the current tendency to delay the treatment of pits and fissures in children's teeth, Hyatt's prophylactic odontotomy and Bodecker's technique of eliminating fissures by carefully grinding them away are now seldom used.[1,2] These methods have been largely replaced by a bonding technique to seal fissures with a resin. Sealants have been much improved since they were first used in 1967.[3-6] Similarly, the preventive composite restoration, which requires a minimal preparation of the tooth and uses a combination of composite and sealant, currently is a good alternative to the traditional amalgam restoration.[7,8] Unfortunately, use of these methods is influenced by an unreliable, traditional method of diagnosing caries, especially of the occlusal surface.[9]

This failure to develop a universally accepted method for diagnosing occlusal caries has led practicing dentists and researchers to view the problem differently.[10-13] Another consequence is that results of epidemiological studies may be distorted, thus making it difficult to compare them accurately. This argument is further supported by the current decrease in total caries, and an increase in the proportion of that total accounted for by occlusal lesions.[14]

In the division of pediatric dentistry of ACTA, the Academic Center of Dentistry of Amsterdam, large dentinal lesions beneath seemingly sound occlusal surfaces are being observed more frequently in recent years. Several dentists in general practice have also reported this phenomenon, believed to be caused in part by fluorides.[15-18]

If there exists a form of caries that is concealed by an intact enamel surface and that exhibits no distinct clinical features, current diagnostic methods are inadequate.

A pilot study was made to gain better understanding of the problem the dentist faces in diagnosing caries beneath an apparently intact enamel surface. This study attempted to evaluate the clinical procedures used to diagnose occlusal caries and also considered the availability of other diagnostic methods, either more reliable than or beneficially supplementary to the examination with mirror, probe, and light.

MATERIAL AND METHODS

To assure the validity of the phenomenon of occlusal caries under an intact enamel surface, we selected for this study ten patients with twenty-six molars and premolars (Table) from among the patients of the Division of Pediatric Dentistry. The teeth were selected by staff

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Table ☐ Patient data collected from study population.

ACTA Patient Number	Sex	Age in years	Tooth	Caries diagnosis: Clinical	Bitewing radiograph	Slide	After opening occlusal surface
1. 81040548	M	11	46	1	not taken	2	NR
			36	1	" "	2	NR
			16	1	" "	4	NR
			26	2	" "	3	+
2. 80100938	M	11	36	3	not taken	3	+ +
			46	3	" "	3	+ +
3. 8011359	M	11	36	3	not taken	3	+ +
			26	1	" "	3	+ +
			16	1	" "	2	NR
4. 77013600	M	14	37	2	+	4	+ +
			27	3	+	2	+ +
5. 77011001	M	14	27	2	±	4	+
			17	1	−	4	NR
6. 85110790	F	18	16	2	+	3	+ +
			26	2	±	3	+
7. 7809254	F	11	17	1	−	1	NR
			27	2	±	3	+
8. 7910345	F	16	36	2	±	3	+
			37	2	unevaluable	3	+ +
9. 86071429	F	13	14	2	+	3	+ +
			35	2	±	2	+
			16	0	+	4	+ +
			46	0	+	1	+ +
10. 7411001	M	17	37	3	+	3	+ +
			17	2	±	3	+ +
			16	2	+	3	+ +

The table shows the results of the diagnosis of occlusal caries according to the following criteria:

Clinical diagnosis: 0 sound; 1 enamel caries; 2 dentine caries doubtful; 3 definite dentinal caries.

Bitewing radiograph: − no discernible radiolucency; ± radiolucency possibly discernible; + radiolucency distinctly discernible.

Slide: 0 sound; 1 enamel caries; 2 dentinal caries doubtful; 3 definite dentinal caries; 4 not evaluable.

After opening occlusal surface: − no dentinal caries; + dentinal caries; + + extensive dentinal caries; NR not relevant (surface not opened).

members with ample pediatric experience. For the diagnosis of caries use was made of a mirror, excellent lighting, and a probe. The posterior teeth had to meet one of the following criteria:

- ☐ Distinct discoloration in a fissure of the occlusal surface.
- ☐ A discoloration appears to be present under the enamel surface.
- ☐ The enamel surrounding the orifice of the discolored fissure is clearly decalcified.

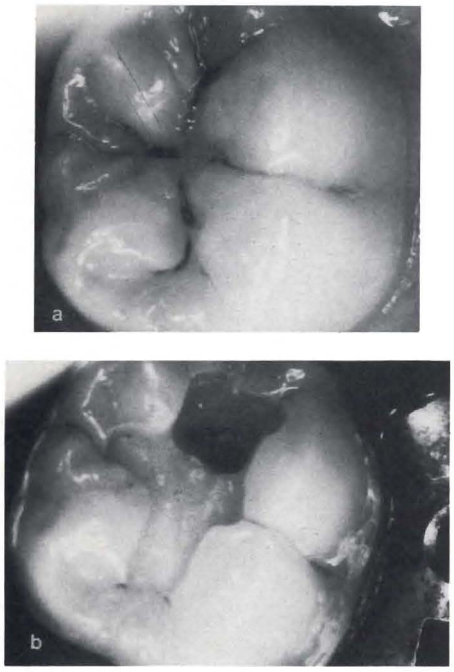
At a subsequent session, these selected teeth, after cleaning with pumice, were reassessed by a staff member who was not involved in the selection. A mirror and good light were used; the probe was used gently, only in doubtful cases.[19]

The presence of discolorations, translucencies, and decalcifications in the fissures was recorded in writing, along with other diagnostic findings: sound-enamel caries, doubtful dentine caries, or definite dentine caries. After three patients, it was decided to take bitewing radiographs as well (one left, one right) and to include these in making the diagnoses of the occlusal surfaces. The projection of this surface on the bitewing radiograph was classified as follows:

- ☐ Distinct radiolucency visible in the dentine.
- ☐ Doubtful radiolucency.
- ☐ No radiolucency is visible.

A slide was prepared of each tooth to record the baseline situation. The final diagnosis was based on the clinical examination and where available, the bitewing radiograph. A distinct radiolucency in the radiograph was always an indication for treatment, even in the absence of clinical signs. When enamel caries was diagnosed, treatment consisted in sealing the element. When presence of dentine caries was doubtful, or the diagnosis of dentine caries was beyond doubt, the fissure was opened to the dentinoenamel-junction, using a small diamond bur. A new clinical assessment was then made and another slide prepared.

Then, all caries was removed, a third slide was made and the tooth was restored using composite and sealant, or amalgam, depending on the size of the cavity.[7]



1. (a) Discolored fissure, clinical diagnosis 2 (See table). (b) Same fissure, after opening + + (see table).

Later, the baseline slides were assessed according to the same criteria used for the clinical examination, and then compared with the clinical and radiographic diagnoses and the clinical findings obtained after opening of the fissure. In a few cases, these findings prompted the decision to open the occlusal surface.

RESULTS

The selection comprised ten patients (six males and four females) aged eleven through eighteen years, with twenty-six molars and premolars (Table). After reassessment, dentine caries was diagnosed clinically in five of them. Bitewings were available of two of these posterior teeth. The bitewing in both cases showed a distinct radiolucency beneath the occlusal surface. In all five posterior teeth, deep dentinal caries was encountered.

In thirteen posterior teeth, the presence of dentine caries was clinically doubtful (see Figures 1a,b). Of ten teeth in this group bitewings were present in which a distinct or possible radiolucency was discernible. In the four cases which showed a distinct radiolucency, treatment exposed extensive dentinal caries. In all thirteen teeth, dentinal caries was found; and in seven cases, the caries was deep.

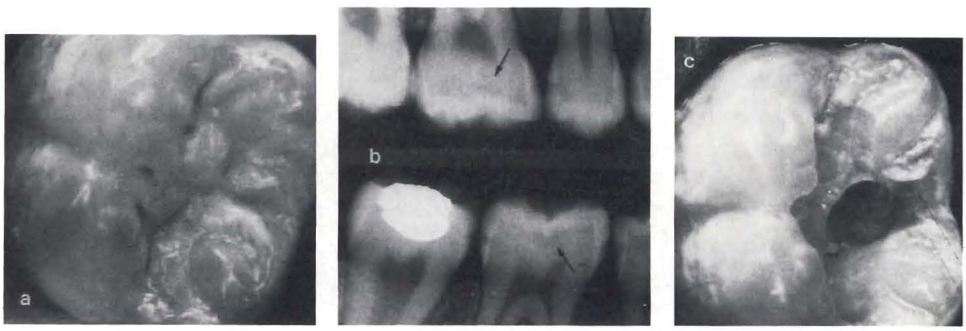
Six posterior teeth were treated with a sealant, because at the time of the diagnosis, opening was not considered justified. In two posterior teeth (Figures 2a,b,c), clinical examination of their occlusal surfaces revealed no discoloration, decalcification, or translucency. The bitewing, on the other hand, showed distinct radiolucencies beneath the occlusal surfaces. Thus, the teeth were opened. Proximal lesions in one of the teeth necessitated a multiface restoration. There was no connection between the proximal lesions and the occlusal surface. In both cases, much carious tissue, of soft consistency and light brown in color, was found.

The other twenty-four teeth exhibited discoloration, translucency, or decalcification in the fissure. All types of discoloration, from light brown to deep black were observed in these teeth.

The slides of the posterior teeth were assessed retrospectively. Unfortunately, not all photographs could be interpreted well. Getting the whole occlusal surface in the photograph initially created some problems, especially where second permanent molars were concerned.

DISCUSSION

The diagnosis of occlusal caries remains unsure and uncertain, attesting to a need for new developments in



2. (a) Fissure, clinically not suspected. (b) Bitewing of the element in question. (c) Fissure, after opening; with rubber dam in place.

this field. The picture of caries is believed to be changing, making the occlusal diagnosis even more difficult, because caries is regularly found beneath a seemingly intact enamel cover. Developments such as measuring the electrical resistance of the tooth have so far failed to provide the desired diagnostic method.[20] Use of lasers also needs further research, while diagnostic transillumination appears to be more suitable for proximal lesions.[9,21,22] The mirror, light, and probe are still the principal diagnostic tools.

As long as no better method of determining the presence and extent of occlusal caries has been developed, it is useful to include the bitewing information in the diagnosis.[23,24] Absence of discernible radiolucency in the bitewing does not justify, however, the conclusion that occlusal dentine caries is indeed absent. An occlusal radiolucency in the bitewing calls for attention; in this pilot study all such teeth, when they were opened, proved to contain a caries lesion in the dentine. In the individual patient, the bitewing may constitute a valuable supplement to the clinical examination or vice versa.

Results of studies show that the caries process in small lesions, and occasionally in larger lesions, may be arrested after sealing.[25-28] This requires, however, complete retention of the sealant and sealing of the entire surface. Proximal cavities should be prevented and the entire tooth should regularly be examined clinically and radiographically. A new port of entry can be expected to lead to rapid increase in the size of the lesion.

Even though caries can be arrested by sealing it off hermetically, it would be premature to conclude that from now on a reliable means of diagnosing occlusal caries would be of less importance.

In six of the posterior teeth selected for this study, the presence of dentine caries could not be established because these teeth were covered with a sealant. Evidently, the patient had been considered at risk. Meticulous control of such teeth is advisable because of the possibility of leakage.

It does not seem premature to conclude from this study that in order to gain maximal information about the possible presence of occlusal dentine caries, bitewing radiographs, in addition to thorough inspection of the fissures, will for the time being be necessary.

As to the slides, the pictures of the posterior teeth tell us more about discolorations, decalcifications, and translucencies than can be discerned by oral examination. This may be due in part to the reflection and the penetrating power of the flashlight used. About three teeth treated with a sealant, doubt arose after assessment of the slide. These teeth, therefore, will be periodically observed. The photograph of one tooth was available before the treatment (patient nr 3, molar 26). The image of the slide was strongly suggestive of dentine caries, much more so than direct inspection in the mouth. After opening, extensive dentinal caries was found.

Presence of discolorations, translucencies, and/or decalcifications was registered in order to have a clear record of the clinical baseline and to enable us, at a later stage, to indicate possible relationships between these data and the final diagnosis. Dental caries can be manifested in so many different forms, however, that no conclusion can be drawn from the material of this pilot study. The impression was gained that decalcification at the entrance to the fissure was present in all cases, but it is sometimes very difficult to discern. Not much is yet known about the part played by fluoride in cases in which dentine lesions are found beneath a seemingly intact enamel surface, but the possibility of its influence cannot be excluded. The increased use of fluoride, among other things, in the form of toothpaste may well play a part in this connection. Further study will be necessary to establish whether regular use of fluoride exerts influence on the occurrence of caries lesions as described in this paper.

CONCLUSIONS

From this study the following preliminary conclusions may be drawn:

- ☐ The mirror, light, and probe are still the principal diagnostic tools.
- ☐ The bitewing radiograph may constitute a valuable addition to the individual clinical examination.
- ☐ It appears that with the aid of slides, a more reliable diagnosis of caries is possible than with mirror, probe, and light.
- ☐ A seemingly intact occlusal enamel surface may conceal an extensive lesion of the dentine.

SUMMARY

The problem of the diagnosis of occlusal caries is discussed on the basis of a pilot study. Out of twenty-six selected molars and premolars with a virtually intact enamel cover, twenty were found to be affected by occlusal caries extending into the dentine. In six cases in which the enamel was covered by a sealant, dentinal caries could not be excluded. Two teeth had a sound enamel surface in spite of the presence of much dentine

caries. The bitewing radiographs of these cases showed a distinct radiolucency.

Until it becomes possible to diagnose occlusal caries more effectively, the combination of bitewing radiograph and clinical examination with mirror, light, and probe is to be regarded as optimal. The dentist in general practice should keep in mind that even a tooth classified as clinically sound may contain extensive dentinal caries. The prevalence of this form of caries should be investigated further, and the search for better diagnostic aids should continue.

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BACKGROUND KNOWLEDGE AND READING ABILITY

In experiments with children, researchers have drawn significant conclusions about the importance of background knowledge for general reading ability. T. Trabasso and his colleagues discovered that differences in reading ability between five-year-olds and eight-year-olds are caused primarily by the older children's possessing more knowledge, not by differences in their memory capacities, reasoning abilities, or control of eye movements.

E.D. Hirsch, Jr.: *Cultural Literacy.*
Boston: Houghton Mifflin Company, 1987, p 47.

Residual contamination of toothbrushes by microorganisms

Infection

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Kazuo Miura, PhD

The use of oral cleaning instruments, such as the toothbrush and dental floss, is essential for removing dental plaque, a contributor to dental caries and periodontitis. Methods of toothbrushing are amply described, but procedures for maintaining their cleanliness are discussed infrequently.

Most of the microorganisms transferred to the toothbrush from the oral cavity or another toothbrush are indigenous microbiota; in cases where the toothbrush was used, however, by patients with infectious diseases such as tuberculosis, viral hepatitis, or AIDS, pathogenic microorganisms can also be transferred. *Streptococcus mutans*, the cariogenic bacterium, is readily transferred, thus increasing the risk of dental caries, particularly for children.

The purpose of this investigation was to study the microorganisms left on toothbrushes after use and rinsing by children.

MATERIALS AND METHODS

The study sample consisted of 150 children: sixty-nine males and eighty-one females. The study was conducted at the Clinical Office of Pedodontics, School of Dentistry, Hiroshima University. Toothbrushes were standardized. New "Dr. Jacks" (Bee-Brand Co., Japan) were used

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Table 1 ☐ The distribution of subjects by study categories.

Group	Drying time (hr)	Age				Evaluation of skill in rinsing			Dental caries				Brushing interval (hr)
		<3	<6	<9	9≦	0	1	2	0	1-5	6≦		
I	0	5	21	15	9	29	14	7	20	20	10		11.0 (0.05-48)
			Ave. 6y3m (2y2m-12y9m)							Ave. 2.82 (0-16)		* *	
II	6	4	29	12	5	28	15	7	16	21	13		5.0 (0.22-24)
			Ave. 5y7m (1y0m-12y4m)							Ave. 3.74 (0-18)		*	
III	24	5	24	15	6	26	16	8	19	24	7		9.3 (0.33-48)
			Ave. 5y11m (1y11m-12y5m)							Ave. 2.16 (0-14)			

* * :P < 0.01, t = 2.9882
* :P < 0.05, t = 2.026

Table 2 ☐ Cfu count per toothbrush after drying in air for 0, 6, and 24 hrs.

Group	Drying time (hr)		BHI	MS	MSB	Rogosa SL	Candida GE
I	0	mean	2.55×10^6	3.01×10^6	4.47×10^4	4.65×10^3	occurrence
		max.	1.81×10^7	1.87×10^7	4.62×10^5	1.08×10^5	8 %
		min.	7.70×10^4	5.45×10^4	4.50×10^2	0	
II	6	mean	3.44×10^5	3.51×10^5	2.55×10^4	3.46×10^2	
		max.	3.12×10^6	2.41×10^6	4.42×10^5	1.03×10^4	2 %
		min.	3.00×10^2	5.00×10	0	0	
III	24	mean	1.12×10^5	5.95×10^4	1.35×10^3	1.60×10	
		max.	9.32×10^5	8.46×10^5	2.82×10^4	5.00×10^2	0 %
		min.	3.50×10^2	1.00×10^2	0	0	

The counts are presented for one toothbrush. Alteration of colony in Candida GE was expressed as its detection.

without dentifrice and rinsed in the normal manner by the subjects. The toothbrushes were collected immediately and placed in a shady room at room temperature (18°C) and allowed to air-dry. The humidity ranged from 26 to 46 percent, during the course of the experiment. The toothbrushes were left in the room for 0,6 or 24 hrs (Group I, II, III, respectively), after which, the heads of the toothbrushes were subjected to sound waves for five minutes in 5 ml of phosphate buffered saline (pbs). Each suspension was diluted 1:10 and 1:100 with pbs, and then 0.1 ml of each dilution was inoculated on an agar plate with conlarge rod. The following agar media were used: Brain Heart Infusion (BHI; Difco Lab., Detroit, USA), Mitis Salivarius (MS; Difco Lab.), Mitis Salivarius with 0.2 unit/ml of bactracin (MSB), Rogosa SL (Difco Lab.,), and Candida GE (Nissui Corp., Japan). Both BHI agar and Candida GE agar were cultured under aerobic conditions. MS agar, MSB agar, and Rogosa SL agar were cultured under anaerobic conditions with BBL Gas Pak system. After the agar plates were incubated at 37°C for 36 hr, the colony forming unit (cfu) was counted. The colonies, formed in each of the media, were named 'BHI colony', 'MS colony', 'MSB colony', 'Rogosa SL colony', and 'Candida GE colony'.

In this investigation, the following variables were studied: 1) the drying time in air, 2) the skill in rinsing the toothbrush after brushing, 3) the number of caries lesions, and 4) age.

Skill in rinsing the toothbrush was assessed and ranked from 0 to 2 as follows:

- ☐ 0 = the toothbrush was rinsed slightly in running tap-water.
- ☐ 1 = the toothbrush was rinsed in running tap-water, using a finger to manipulate the bristles slightly.
- ☐ 2 = the toothbrush was rinsed well in running tap-water, using a finger to manipulate the bristles vigorously.

In cases where the brusher or rinser was the child's parent, the data were dealt with in the same manner, and analyzed using a t-test and the Mann-Whitney U-test.

RESULTS

Categorical distribution of subjects

Table 1 shows the categorical distribution of subjects. The only differences between the groups were the brushing intervals. The correlations between variables were not calculated.

Drying time

Table 2 lists the cfu count on each of the media plates for various *drying times in air*.

Figure 1 illustrates the relation of the cfu count to the *drying time in air*. As the drying time increases, the cfu count drastically decreases. Nearly 60 percent of the MSB agar colonies, however, were still alive in group II.

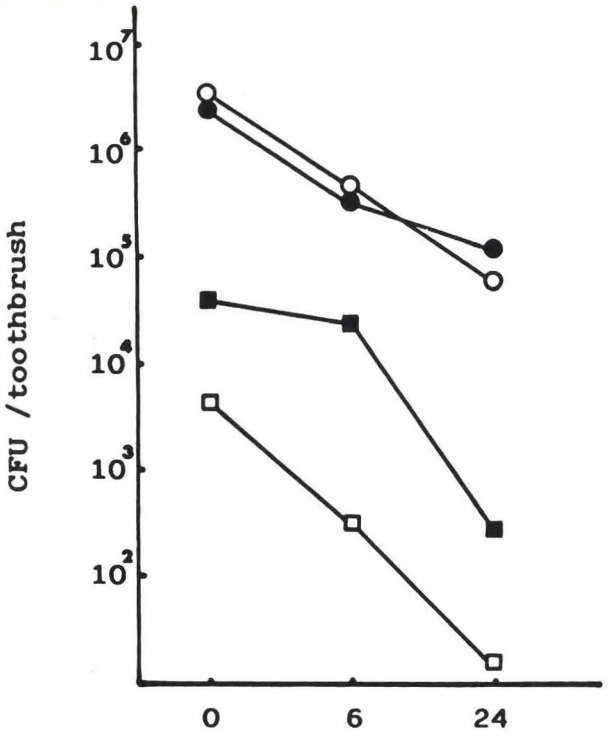

Figure 1. Relation of the cfu counts to drying time (in air). ● *BHI colony,* ○ *MS colony,* ■ *MSB colony,* □ *Rogosa SL colony.*

Evaluation of skill in rinsing

Figure 2 illustrates the relation of the cfu count to the skill in rinsing the toothbrush. As the skill factor increases, the cfu count is effectively decreased. The distribution of the skill factor can be seen in Table 1; for example, "value 1" was assigned to twenty-nine of the fifty people in group I. It is of interest to note that "value 2" applied to only 15 percent of all subjects. Not shown is the observation that there was little difference between the rinsing skills of children and those of their parents.

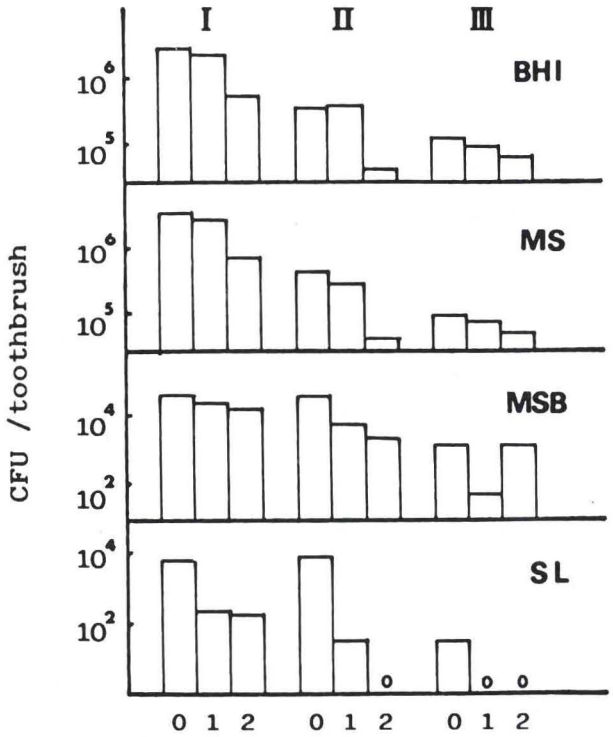

Figure 2. Relation of the cfu counts to extent of toothbrush rinsing: group I, drying time 0; group II, drying time 6h; group III, drying time 24h.

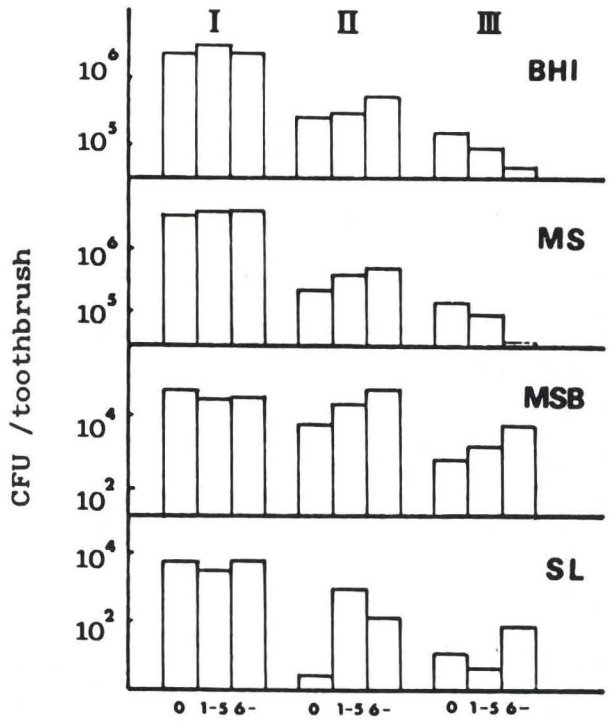

Figure 3. Relation of the cfu counts to the number, of carious teeth: groups I, II and III are the same as in Figure 2.

Dental caries

Figure 3 illustrates the relation of the cfu count as a function of the number of teeth with dental caries. The data are arranged according to the three study-groups. A large number of microorganisms appeared in all media in group I. In the BHI, MS, and MSB agar plates of group II and the MSB agar plates of group III, the cfu count increased with the number of dental caries lesions present. In the BHI and MS agar plates of group III, however, the cfu count decreases with the number of dental caries lesions.

Age

Figure 4 illustrates the relation of the cfu count to age of subject. Four age-groupings were used. In group I, all plates contained large colony concentrations, irrespective of age. In the 'BHI colony' and 'MS colony' plates of group III, the cfu counts increased with age, but no statistical correlation was calculated.

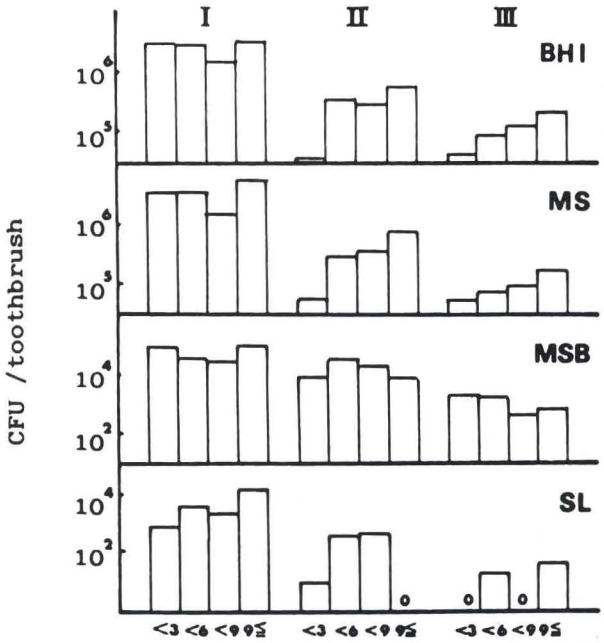

Figure 4. Relation of the cfu count to subjects' ages: groups I, II, III are the same as in Figure 2.

DISCUSSION

Clinical interest in toothbrush contamination increased in recent years. Glass *et al* concluded that contaminated toothbrushes may play a role in various diseases and should be changed once a month.[1] In households, daily procedures for preventing contamination consist mainly of rinsing and drying the toothbrushes.

The results of our study, however, reveal that many microorganisms remain on the bristles of toothbrushes after usage and cleaning with this general method. Considering that as many as 11 x 10^5 BHI colonies were detected on one toothbrush, even after 24 hrs of drying, it is possible that multiple strains could be replanted in the oral cavity by further usage of the same toothbrush. This result strongly implies that air-drying of toothbrushes may be an incomplete method for disposing of microorganisms.

Svanberg examined the contamination by *S. mutans* of toothbrushes and toothpaste and suggested the possibility of spreading *S. mutans* by the use of ordinary oral hygiene methods.[2]

This study found that *S. mutans* occupied 'MSB colonies' more than other colonies and tended to remain on the toothbrush after 6 hrs of air-drying. This is because *S. mutans* chiefly exists in dental plaque, which is adhesive, moist, and difficult to remove from toothbrushes or to dry.

The number of microorganisms remaining on toothbrushes was markedly affected by the skill in rinsing. Toothbrushes, rinsed well (value 2), contained less than half of the microorganisms of those that were rinsed poorly (value 0). The problem is that as many as 60 percent of the toothbrushes were not rinsed well. Furthermore, even toothbrushes that were rinsed well still contained large numbers of microorganisms.

Figure 3 shows that microorganisms remain, regardless of the number of caries lesions. Not shown in the Figure is the fact that the number of microorganisms in all media increased for the 24 hr brushing interval. This indicates that toothbrushes used only once a day may contain a surprisingly large number of microorganisms.

Lehmer *et al* studied toothbrush care with various bactericidal rinsing solutions.[3] Dayoub *et al* designed a vented container to protect toothbrushes from contamination.[4]

It is suggested that sterilization equipment or a specific detergent be used to sterilize toothbrushes and other instruments that are used in the home to clean the oral tissues.

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Relationships between def, demographic and behavioral variables among multiracial preschool children

Demography

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In the past decade, a dramatic decline in dental caries has been documented in the United States.[1] The National Dental Caries Prevalence Survey of 1979-1980 showed a reduction among school children for average decayed, extracted, or filled teeth (def) from 7.1 to 4.8 from 1970 to 1980.[2] Recent surveys of preschool children, also reported lower def levels than earlier studies, although 18 percent to 36 percent of these children had at least one cavity.[3,4] Few surveys have been conducted with preschool children, however, and most research did not involve multiracial groups. In order to design a preventive dental health education program for the multiracial preschool children served by health department clinics, it was necessary to survey the dental status for that particular population.

The purpose of this survey was to:

- ☐ Examine the extent of def among children six months to five years of age who attend maternal and child health clinics in the City of Fort Worth.
- ☐ Determine potential relationships between def and demographic variables, parental characteristics, nutritional characteristics, or oral health practices.

The authors were with the Fort Worth Public Health Department, Fort Worth, TX, when this study was undertaken.

Research on dental caries in children has related def to age, parental characteristics, and food consumption patterns. Socioeconomic and ethnic variation have rarely been studied as a factor in def differences among children.

Age is an independent variable with tremendous impact upon other environmental factors, because the dentition, as an organ, has none of the healing capacity of other body organs. The limited surveys of preschool children in the U.S. demonstrate caries levels that generally increase with age.[5] Weddell and Klein cited def ranges of 0.128 at twelve months of age to 1.101 at thirty-six months.[3] Other researchers found higher def ranges of 1.23 to 1.36 among children two years old and 2.79 to 3.63 among those four to five years old.[6,7]

The degree of experience that a parent or guardian has may influence def. Higher caries prevalence in children has been associated with younger parental age at time of child's birth, and completed education levels at or below high school.[8-11] Birth order of the child has been examined in some studies, but has not been consistently associated with caries prevalence.[8,9] There are no data available to correlate the person responsible for oral health (mother alone, mother and child, child alone) and def. Research seems to concentrate on the influence of family values and parental dental health practices on children's dental behavior.[11,12]

The consumption of various foods may compound dental problems in the preschool child. For example, frequency of sucrose consumption has been associated with a high incidence of dental caries.[13,14] Allowing a child to go to bed with a bottle has also been related to a higher prevalence of caries.[9,10]

Few studies have compared the incidence of dental caries among children of different ethnic or socioeconomic groups. One study of black and white children found that the incidence of caries was unrelated to ethnicity or socioeconomic level.[3] Other research determined def values of Hispanic preschool children to be at high levels ranging from 3.5 to 3.8.[15,16]

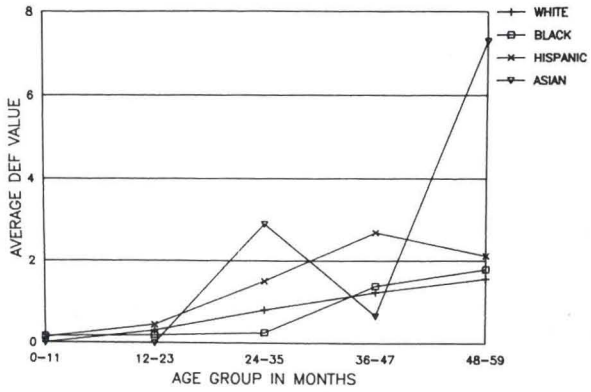

Figure 1. Average def by race and age.

Table 1 ☐ Distribution of sampled children by age and race.

Age (months)	White	Black	Hispanic	Asian	Total
0-11	29	45	42	5	121
12-23	61	88	89	13	251
24-35	36	69	109	10	224
36-47	34	59	65	3	161
48-59	25	33	57	9	124
60+	1	1	4	1	7
Totals	186	295	366	41	888

Table 2* ☐ Def scores by milk intake and child's age.

	Age			
Milk intake score	1	2	3	4
0-7	1.13	1.43	2.11	2.67
8-17	.46	1.33	3.00	3.28
18-27	.20	1.21	1.95	1.93
28-37	.27	1.27	1.38	1.45
38+	.30	.33	1.90	1.75

*Predicted def = age (.62) + milk score (−.02) + .53

Table 3* ☐ Def scores by number of times fed day and child's age.

	Age			
# Times fed day	1	2	3	4
3	.615	.800	1.087	2.593
4	.254	.595	1.492	2.048
5	.189	1.078	2.344	2.714
6	.304	1.207	2.067	1.000
7	.813	.500	2.333	12.000
8	.333	2.875	2.900	2.125

*Predicted def = age (1.09) + number of times fed (.34) − 2.74

METHODS

During 1984-85, 891 children six months to sixty months of age were examined for def. Examinations were performed by public health nurses at seven maternal-child health clinics located in low income neighborhoods of Fort Worth. These neighborhoods were predominately black and Hispanic. To obtain a representative sample of clients evenly distributed across age, sex, and racial-ethnic categories, a stratified sampling strategy was undertaken. Nurses were instructed to survey all white and Asian children. Black and Hispanic children were surveyed as follows: six months to one year of age, every second child; and one to five years of age, every third child. Parental consent was obtained.

Nurses were trained by a local pedodontist, to identify caries, followed by individual instruction in visual oral examination techniques from the Health Depart-

ment's dental hygienist. Tooth eruption charts were placed in each examination room along with photographs of the following: beginning occlusal decay, beginning interproximal decay, severe nursing caries, abscess, severely inflamed tissue, and a healthy normal mouth. Selected information was obtained by questionnaire on demographic variables, parental characteristics, nutritional characteristics, and oral health practices. Questionnaire items were developed based on a review of the literature.

Tabulation of data was facilitated by using the SPSS subroutine breakdown.[17] Multiple regression analyses were used to develop models useful in explaining def scores by various combinations of independent variables. The stepwise regression approach was used to derive equations explaining the maximum amount of variance of the def and provide direction for focusing intervention efforts.

RESULTS

The age and racial distribution of the sample surveyed is presented in Table 1. Def values by race and age are found in Figure 1.

White and black children had the lowest def values. Black children's def scores exceeded white children's after age three. Hispanic children had the highest overall def values. Def values for Asian children over age two were higher than those of whites, blacks or Hispanics. The extreme variability of the Asian children's scores is most likely a function of sample size. Twenty-three percent of the total sample had at least 1 decayed, extracted or filled tooth. By age five years the average def ranged from 1.6 for white children, to 1.8 for black and 2.1 for Hispanic children. Asian children averaged over 7.

Nutritional factors

The milk intake score for children was based on a twenty-four- hour recall with raw scores ranging from 0 to 60. High scores indicated high milk intake. Scores were collapsed into five groups (Table 2). A formula was derived using age and milk intake as variables with an r^2 equal to .79.

def = age (.62) + milk score (-.02) + .53

(Almost 80 percent of the variability in def could be explained by this formula). When milk intake and age were examined by ethnic group, r^2 values dropped (white = .27, black = .45, Hispanic = .58). Thus, as milk intake increased, the def decreased for each group. This relationship was strongest for black and Hispanic children.

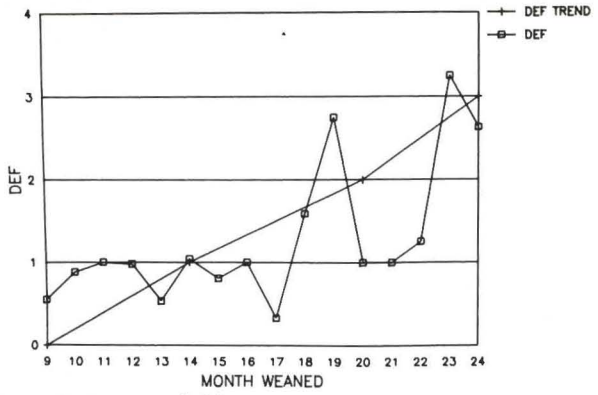

Figure 2. Average def by age at weaning.

The def value increased with an increase in servings of high sugar foods per day. When age and sugar intake are examined without accounting for ethnicity the formula:

def = age (.70) + sugar intake (.07) - .42 is derived.

This relationship may explain almost 60 percent of the variability of the def (r^2 = .605). Accounting for ethnicity the effect of sugar intake appears to be greatest in the black sample (r^2: white = .26, black = .77, Hispanic = .28).

Children fed most often had higher def values (Table 3). In this instance, the formula derived was:

def = age (1.09) + number of times fed (.34) - 2.74.

Black and Hispanic children were equally affected by this relationship (where r^2: white = .19, black = .37, and Hispanic = .35).

Children who took bottles to bed had higher def values (Table 4). Early weaning was related to decreased def values (r^2 = .648; see Figure 2) with weaning having the greatest influence on black children (r^2 = .74).

A correlation matrix of nutrition-related variables was constructed to determine their potential interrelationships (Table 5). The number of high sugar and milk servings increased with increased numbers of food servings. The number of total servings increased with delayed weaning. Early weaning, however, was associated with increased milk servings. Increased milk servings were also associated with lower sugar intake.

Table 4 ☐ Def scores by age and bottle use at bedtime.

	Bottle use	
Age	Yes	No
1	.311	.347
2	1.333	.931
3	2.2	1.783
4	8.0	2.411

Table 5 ☐ Correlation matrix (r) of nutrition-related variables.

Number high sugar servings		Daily milk score	Age of weaning
Number of daily servings	.10	.11	.14
Number of high sugar servings	–	-.11	.08
Daily milk scores	–	–	-.23*

*p≤ .001

Demographic factors

Relevant demographic characteristics of the four ethnic groups studied are presented in Table 6. Hispanic and Asian women tended to be older, have less education, and postpone weaning relative to white and black mothers. Figure 3 indicates that as education increases, def values decrease, (r^2 = .464). Paradoxically, the children of Hispanic mothers with higher education levels had higher def values. The mother's age appeared to have little influence on the def values. Def scores, examined by mother's age, showed little effect for children two years of age (r^2 = .05) and three years of age (r^2 = .08). Birth order contributed to the def in that as the child's birth order increased, the average def increased (age one, r^2 = .78; age two, r^2 = .28; age three, r^2 = .51; and age four, r^2 = .46).

Dental factors

Less than 10 percent of children in this sample had ever seen a dentist. White and Asian children were more likely to have seen a dentist than black or Hispanic children (Figure 4). Children who visited a dentist most often had, as expected, a greater number of filled teeth. In this sample, 18 percent of the white children and 15 percent of the black children had one or more untreated carious teeth. Of the Asian and Hispanic children, 33 percent, however, had untreated cavities.

The effects of the changing responsibility for oral hygiene with age can be seen in Table 7. Little cleaning was done before age one. At one year the mother takes responsibility for cleaning the child's teeth and gums. At two years the mother and child interact most frequently for cleaning. After age three, the child takes over cleaning activity. The number of cleanings per day increased with mother's involvement. A correlation coefficient of r^2 = .29 was found. (The variables were treated as continuous because they represented a real order of magnitude). Children over three years who interacted with their mothers for total cleaning had lower def values than those who did not clean their teeth or had no help. This relationship is strongest for blacks (r^2 = .60) and Hispanics (r^2 = .50) and lowest for whites (r^2 = .15).

When age and the number of cleanings per day were examined in relation to the def, the following formula was derived:

def = age (.70) + times cleaned (.13) - .32

Examination of Table 8 reveals no clear downward trend of the def, when the number of teeth cleanings per day increased within each age cohort.

Table 6 ☐ Mother and child by ethnicity and selected demographic characteristics.

	Median age of mother	Median education of mother	Median birth order of child	Median age weaned, child
White	23.5 yrs	12 yrs	1	14.1 mo
Black	23.5	12	1	14.6
Hispanic	24.5	8.5	2	16.2
Asian	28.5	9	2	18.1

Table 7 ☐ Def by who cleans teeth by age.

	Child's age			
Hygiene responsibility	(12-23)	(24-35)	(36-47)	(48-59)
No one/no answer	.103	1.568	2.423	2.308
Child	.917	1.0	1.9	2.735
Mother	.412	1.375	1.609	1.846
Child and mother	.211	.364	1.615	2.0

Table 8* ☐ Def scores by times cleaned and child's age.

	Age			
# Time Cleaned	1	2	3	4
0	.13	1.27	2.04	1.33
1	.42	.80	4.52	2.44
2	.37	1.40	1.63	2.13
3+	.88	1.00	2.33	3.17

*Predicted def = age (.70) + times cleaned (.13) − .32

DISCUSSION

The lack of previous studies on the dental status of preschool children inhibits comparisons between the findings of this study and others. Although there were some similarities noted, there were also contrasts found with other studies that reviewed the problem of preschool def.

Def by race

The increased def values for Hispanic children compared to black and white children is consistent with the

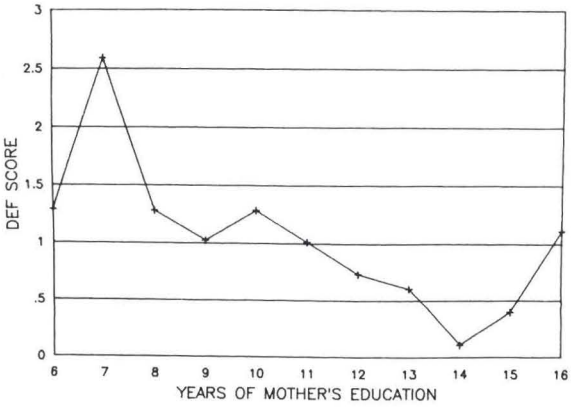

Figure 3. Def by mother's education.

literature. The lack of significant differences in def values between black and white children agrees with the 1981 study by Weddell and Klein.[3] In contrast to Weddell and Klein's findings, the data from the present study show, however, that the def scores of black children exceeded those of whites after age three. The high def value for Asian children in this study is suggestive rather than conclusive, due to the small sample size. The recent immigration status of many of the Asians surveyed suggests, however, the possibility of both poor nutrition and dental hygiene, making this a high risk group in need of further study and intervention.

Nutritional factors

Findings regarding sugar intake and increased def values were consistent with previous studies, as was the positive relationship found between taking the bottle to bed and increased caries incidence.[9,10,13,14] There were no previous studies that related sugar intake, weaning practices and total daily consumption of milk. Further studies regarding nutritional patterns and practices with regard to dental status are needed, to confirm the relationship between these variables.

Demographic factors

The findings from this study do not support those found earlier by Primosch, who suggested a significant relationship between mother's age and def values.[8] Conversely, a positive relationship was found between birth order and caries incidence, which adds further information to earlier contradicting research results.[8,9] Findings relating lower parental education levels with high caries incidence in the children agreed with earlier studies, except with Hispanic families where the opposite trend was found.[9-11] Further study will be necessary to determine whether there is some cultural difference or some intervening variable causing this reversal of the expected finding for Hispanic families.

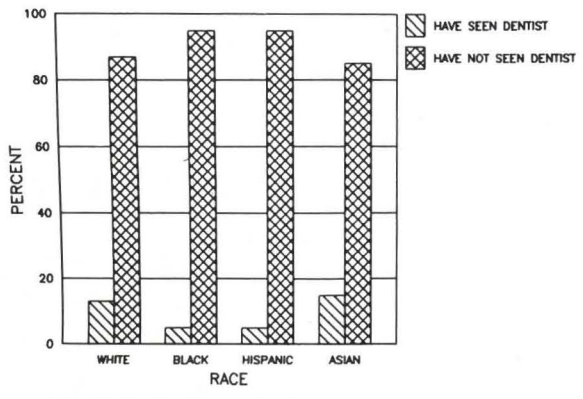

Figure 4. Percentage of children who have/have not seen a dentist.

Oral health practices

Since no research correlating age, participation by parents and frequency of brushing has been noted, no comparison of results can be made. Those findings suggest, however, that prolonged participation by parents in tooth cleaning is a necessary component in a preschool child's dental hygiene and that the quality of the cleaning rather than the frequency might be stressed. This is also suggested by the lack of relationship in this study found between the def values and the number of cleanings daily.

CONCLUSIONS

In general, these data suggest that children's dental health is related to certain practices undertaken during the infant and preschool years. Specific interventions such as early weaning, parent-assisted toothcleaning, and the offering of diets high in milk and low in sugar will decrease the incidence of caries in children. The findings also indicate that certain preschool populations are at increased risk i.e., Hispanics, Asians and children of parents with lower levels of education. Considering these findings, the following implications for practice can be stated.

Implications

- ☐ The higher def values for Hispanic and Asian children suggest the need to target these groups for earlier education and intervention.
- ☐ The apparent association between higher def values and lower education levels suggests the need to target these parents and their children for education and intervention.
- ☐ Utilization of dental services should be promoted and made accessible to all ethnic groups.
- ☐ The increase in def values corresponding to decreased parental assistance with toothbrushing suggests educating mothers to continue assistance with brushing up to age five, particularly in the black and Hispanic populations.
- ☐ Further studies are recommended to determine reasons for the reversed trend in Hispanic families regarding def values and education levels, and to determine the relationship between def values and parity and mother's age.

- ☐ Since higher def values are associated with higher sugar intake and more frequent feedings, nutritional education should stress lower dietary sugar and limited snacking.
- ☐ The inverse relationship between milk, sugar and def values for all age groups suggests encouraging higher milk intakes, especially in Hispanic and black families where the relationship was strongest.
- ☐ Children weaned earlier had more milk in the diet and less sugar. Earlier weaning was also related to lower def values. Thus weaning by age 1 should be encouraged, especially for Hispanic and Asian children.
- ☐ Since def values increased with increased birth order, mothers should be encouraged and supported to persist with effective dental hygiene practices for all their children.

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BIOLOGICAL RESEARCH HAS A SPECIAL FLAVOR

What gives biological research its special flavor is the long-continued operation of natural selection. Every organism, every cell, and all the larger biochemical molecules are the end result of a long intricate process, often stretching back several billion years. This makes biology a very different kind of subject from physics. Physics, either in its more basic forms, such as the study of the fundamental particles and their interactions, or in its more applied branches, such as geophysics or astronomy, is very different from biology. It is true that in the latter two branches we have to deal with changes over comparable periods of time and what we see may be the end result of a long historical process. . . . while stars may "evolve," they do not evolve by natural selection. Outside biology, we do not see the process of exact geometrical replication, which, together with the replication of mutants, leads to rare events becoming common. Even if we may occasionally glimpse an approximation to such a process, it certainly does not happen over and over again, till complexity is added to complexity.

Crick, Francis: *What mad pursuit*.
New York: Basic Books, Inc., 1988, p 137.

Special pediatric population groups and their use of dental services

H. Barry Waldman, BA, DDS, MPH, PhD

Pediatric dentists (and general practitioners) are reaching segments of the population which, in the past, may have never received dental services or for which dental services may have consisted primarily of emergency procedures to eliminate pain and infection."[1]

Demographic classifications generally are used to categorize populations into age, gender, race, residence, education, economic, and other comparable cohorts. From a dental service delivery perspective, however, there also is a need to consider individuals in terms of general medical status and the problems which must be considered when treating populations with particular medical problems.*

As a result of special training and experiences, many pediatric dentists are at the forefront in the care of the special population groups: the developmentally disabled, the chronically and acutely ill, the hospitalized, the high-risk patient, and any number of others with special needs.

An awareness of the existence and needs (in particular, dental needs) of these special groups of patients has been slow in reaching national exposure. In the 1961 report by the Commission on the Survey of Dentistry in the United States, recommendations for the special younger population and the handicapped population were made:

"Existing crippled children's service programs (should) be expanded as rapidly as possible to include comprehensive care for children with oral clefts and other severe dentofacial deformities requiring orthodontic treatment." [3]

"The Public Health Service and state and local dental agencies (should) expand demonstration projects and experimentations in special problem areas such as radiation protection, rehabilitation of the handicapped, and the provision of dental care for the homebound, aged and chronically ill." [3]

In general, the view was that the special problems of "the handicapped" (little attention was directed to the wide diversity within the single category of "the handicapped") were the domain of the public health dentist. In the almost thirty years since the Survey was undertaken, increasing attention has been directed to the particular needs and care of these special population groups.

SPECIAL CHILD PATIENTS

☐ Who are they?

Establishing definitional identifications for the varying special patients, both child and adult, is not a simple task. The term "handicapped" has been used synonymously with the phrases, "developmentally disabled," "disabled," "exceptional," "mentally retarded", and "crippled." The term "developmentally disabled,"

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*Note: Some material in this presentation was prepared for a report to the American Academy of Pediatric Dentistry.[2]

currently used by the federal government (Developmentally Disabled Assistance and Bill of Rights Public Law No. 95-602), defines a developmental disability functionally as a severe, chronic disability attributed to a mental and/or physical impairment that is manifested before a person reaches the age of twenty-two. This disability affects people in a variety of major areas of life, including self-care, learning, self-direction economic sufficiency, receptive and expressive language, mobility or capacity for independent living.[4] In addition, various administrative requirements of funding agencies frequently require categorization of developmental disabilities by diagnostic labels, such as mental retardation, cerebral palsy, epilepsy, autism, and dyslexia. Head Start developed other varying categories of impairment, including blindness, visual impairment, physical handicap, speech impairment, health impairment, mental retardation, serious emotional disturbance, and specific learning disabilities. Included in the health impairment criteria are severe dental caries, periodontal disease, or structural malformations that interfere with adequate mastication.[4,5]

□ How many are there?

One approach to identifying the number of developmentally disabled in the country has been by determining the number of handicapped people receiving special education and related services. By the 1984-85 academic year, a total of 4.3 million handicapped persons received services, an increase of 16 percent between 1976-77 and 1984-85. In 1984-85, handicapped children represented almost 11 percent of the total number of children enrolled in preschool through the 12th grade. The most frequently reported handicapping conditions included learning disability (4.4 percent), speech impairment (2.9 percent), and mental retardation.[6,7]

The number of handicapped children in preschool programs increased from less than 200,000 in 1976-77 to almost 260,000 in 1984-85, a 32 percent increase. It should be noted that these rates do not include handicapped children not requiring special educational services. It has been estimated that as many as one million additional handicapped children are not being counted by the U.S. Department of Education because they do not need educational services. There has been a trend toward normalization or deinstitutionalization of handicapped people. Thus, they are being educated and trained for life in the community in some structured environment or with nonhandicapped individuals.[6,7]

□ What dental services are needed?

No nationwide studies have been conducted to determine the prevalence of dental disease amongst the various special population cohorts. Numerous local and regional reports and summaries of these reports, however, provide a general appreciation for the needs of these special children. Yet, as one attempts to determine the dental health status of handicapped children, various problems arise, including the fact that often the status of the young are a component of a composite review of the general population of the handicapped and the need to separate the increasing attention to the handicapped elderly from the passing commentaries on the particular conditions of the young.

Overall, there is a general agreement by many reviewers that the handicapped population has higher rates than the nonhandicapped population, for poor oral hygiene, gingivitis, and periodontitis.[10] Moderate or severe gingivitis has been found almost universally, with degree and extent increasing with age and degree of mental retardation and Down syndrome.[11,12] Local factors such as macroglossia, malocclusion, tooth morphology, lack of normal masticatory function and bruxism have been suggested as contributory factors.[13]

There is considerably less agreement, stemming from the variation in the residence of the population, regarding caries rates among people with handicapping conditions. Whether a person is institutionalized or noninstitutionalized makes a difference with regard to the daily personal care that is provided, including personal hygiene, diet, exercise, socialization, and sleep. In addition, there also is the question of whether the young residents of large institutions, many of which are in rural areas and far away from central supplies of water, receive optimal levels of fluoride.[14] In general, the findings of a variety of studies indicate that the handicapped children have a higher DMFT rate than their nonhandicapped counterparts.[14,15] Special populations, however, cannot be considered as a single homogenous grouping. For example:

□ In fluoridated communities, although DMFT scores are lower than in those in nonfluoridated communities, older children have higher DMFT scores than younger children.

□ In fluoridated communities, mentally handicapped and Down syndrome children have higher DMFT scores than children with cerebral palsy.

□ In nonfluoridated communities, children with cerebral palsy have higher DMFT scores than children who are mentally handicapped or have Down syndrome.[14]

Further reports indicate:

□ The prevalence of dental caries and periodontal disease in mental retardation is the result of multiple factors, including age, degree of mental retardation,

Table 1 ☐ Self assessment of health and limitation of activities for population under seventeen years: 1975, 1980, 1985.[17]

	1975	1980	1985
	(In millions)		
Total population under 17 years	61.9	57.8	62.8
Self assessment of health			
Fair or poor	2.7	2.5	1.6
With limitation of activities			
Limited but not in major activity	1.1	1.0	.9
Limited in amount or kind of major activity	1.1	1.1	2.0
Unable to carry on major activity	.1	<.1	.3
Total with limitations	2.3	2.2	3.1

Table 2 ☐ Percent distribution of children with a dental visit in the past year by limitation of activities, 1986.[16]

	Age		
	2-4 Years	5-11 Years	12-17 Years
No limitations	31.1%	70.7%	70.2%
Limited but not in major activity	48.0*	74.0	72.8
Limited in amount or kind of major activity	37.9*	68.5	63.3
Unable to carry on major activity	24.7*	72.1*	53.4*

*Relative standard error greater than 30 percent

institutionalization, and oral hygiene.

☐ The low caries prevalence often reported in the institutionalized is probably as much a result of the degree of retardation as the institutional status itself. Individuals with profound mental retardation are institutionalized more frequently; those individuals with mild and moderate mental retardation usually reside at home.

☐ High prevalence of gingival and periodontal disease in the mentally retarded appears to be clinically significant, but varies among the many subgroups.

☐ There is a high prevalence of periodontal disease at an early age with a low prevalence of dental caries in children with Down syndrome.[9]

USE OF DENTAL SERVICES

Once again, determining the use of dental services reflects definitional differences. For example, the National Health Interview Survey considers variations in the use of dental services on the basis of personal activity limitations.† These limitations result from an assortment of chronic conditions, including arthritis and rheumatism, heart conditions, hypertension without heart involvement, diabetes, mental and nervous conditions, asthmas, impairments of back or spine, impairments of lower extremities, visual impairments, and hearing impairments.

Although this approach may vary from the criteria set forth in the Developmentally Disabled Assistance and Bill of Rights Act (see above), it does provide some insight into the use of dental services by children with varying physical and mental limitations.

☐ Number of children with activity limitations

In 1985, 1.6 million children, less than seventeen years of age, were reported to be in fair to poor health. This represented a decrease of approximately a million from the number in the mid and the late 1970s. In 1985, more than three million children had varying limitations, however, in major and minor activities, an increase from 2.3 million in 1975 (Table 1).

☐ Dental visits and activity limitations

In 1986, 31 percent of children with no limitations, between two and four years of age, and 70 percent between five and eleven years, and twelve and seventeen years, reported a dental visit in the previous year. Children in the three age-cohorts, who had limitation of activities, reported varying use patterns of dental visits. In some instances, there was a greater percent and in other instances a smaller percent with reported dental visits in the previous years (Table 2).‡ But, most important, is the finding that, children with limitations are using dental services and practitioners must be prepaid to provide this needed care.

WHO PROVIDES THE DENTAL SERVICES?

The results from a nationwide survey of dentists regarding their training, clinical experience, attitudes, and practice patterns relative to children who are mentally and physically handicapped, provide some insight into

†Limitation of activity refers to a long-term reduction in a person's capacity to perform the average kind or amount of activities associated with his or her age-group. The major activities for the age-groups are: ordinary play, for children under 5 years of age; attending school, for those 5-17 years of age.[16]

‡It should be noted that, some percent data reported in the National Health Interview Survey reports have relative standard errors in excess of 30 percent and, therefore, should be used with extreme care.

The relative standard error of an estimate is obtained by dividing the standard error (i.e. primarily a measure of sampling variation) by the estimate itself and is expressed as a percentage of the estimate.[16]

the critical role played by pediatric dentists in serving the needs of these special patients.

- ☐ Practitioner training experience is related closely to whether or not handicapped children are treated. If practitioners attended a postgraduate pediatric training program, or received classroom education, or clinical training in the treatment of handicapped children, they are more likely to treat such patients.
- ☐ Twelve percent of general practitioners and 72 percent of pediatric dentists received education in dental treatment of handicapped children as part of a postdoctoral or graduate program.
- ☐ Eighty percent of pediatric dentists received formal classroom instruction and 72 percent received clinical training in the treatment of handicapped children; compared to 36 percent and 25 percent respectively for general practitioners.
- ☐ Substantially more dentists who received education in the treatment of the handicapped, reported that they treated these patients.
- ☐ Overall, 49 percent of general practitioners and 96 percent of pediatric dentists reported treating handicapped children.[18]

Further, it is the pediatric dentist who increasingly is being called upon to treat the dental needs of a "new" special patient population, the survivors of medical conditions who previously succumbed to a seemingly endless range of morbidities: hydrocephalus, epilepsy, spinal cord injuries, spina bifida, cerebral palsy, major cardiovascular anomalies, neonatal abnormalities, kidney dialysis, a wide range of blood dyscrasias, immunosuppressant diseases (including AIDS), muscular dystrophy, multiple sclerosis, juvenile diabetes, and complex endocrine abnormalities.

For example, one writer commented that, "cancer is now a chronic disease in children."[19] Between the 1950s and the 1980s, improvements in care and treatment have led to a marked increase in the five-year relative survival rates for Hodgkin's disease, from 16 percent to 83 percent; Wilms' tumor, from one percent to 72 percent; leukemia, from zero percent to 50 percent; and Ewing's sarcoma, from 6 percent to 42 percent.[19]

Unfortunately, the children may experience a host of cure- related physical, psychological, social, and associated difficulties. These include radiation-induced abnormalities, cognitive defects, behavioral problems, short attention-span, poor concentration, distractibility, social isolation, and any variety of skeletal, neurological, endocrinological, genetic, sexual, and central nervous system problems.[20-22]

Indeed, the particular complex needs of the new special population of pediatric survivors requires a working relationship between the medical team and the pediatric dentist with advanced training.

OVERVIEW

Reports from the National Health Interview Surveys in the 1980s document the increase in the use of dental services by the general population and by children of all ages, males and females, whites and blacks and in all family income groups.[23,24] And, children with limitations are using dental services.

The reality is that during this general improving environment for the dental profession, there has been, and apparently will continue to be, a continuing increase in the number of long-term surviving individuals in the various special medical populations. But the special training and experience of pediatric dentists is ensuring the necessary expertise to provide services to many of these patients. In addition, the curricula of many schools of dentistry have been enhanced to provide didactic and clinical experiences in the care of these special patients.

In general, the outlook for the dental profession, including pediatric dentistry, continues to improve.

"Projected increases in the number of children, an increasing awareness of the need for, and value of dental services, and increase in the number of young parents whose own personal favorable experience with dental services is associated with high-speed dentistry and other major technical and material advances, increasing third-party coverage, and an increase in the percent of children using the services of dentists—all augur favorably for the future of pediatric dental practice." [25]

But in particular, pediatric practitioners, continue to increase their awareness of, and their ability to provide for the expanding needed care of special pediatric population groups that are seeking dental services.

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HERPETIC GINGIVOSTOMATITIS

An acute course herpes simplex infection with associated stomatitis. Most affected are children after infancy (decrease of passively transmitted maternal antibodies) up to about age four. Older children and young adults are less frequently affected.

The anterior part of the oral cavity is the favored location, where numerous irregularly distributed blisters develop that have a watery content that becomes cloudy. After rupture of the blister roof there are very painful, irregular, but sharply delimited lesions that are surrounded by a red halo and that tend to coalesce. There can be development of large zones of erosion which are coated with a whitish or yellowish pseudomembranous coating.

Preferred locations are the gingiva, tongue, lips, and cheeks; less commonly the palate. The tonsils and throat are usually not affected.

The appearance of the erosions is accompanied by an acute gingivitis and a sialorrheal stomatitis with halitosis, coated tongue, fever, and lymphadenitis.

Of diagnostic relevance is the finding that no similar stomatitis or a limited herpetic infection were present before. Often it is possible to find a person whom the patient was in contact with who has a recurrent herpes simplex infection and is the cause of the problem.

Bengel, *et al: Differential diagnosis of diseases of the oral mucosa*.
Chicago: Quintessence Publishing Co., Inc., 1989, p 212

Continuing potential for pediatric dental services in nonurban areas

H. Barry Waldman, BA, DDS, MPH, PhD

The conclusion of an earlier writing (summarizing available general population and pediatric data from the 1970s through 1980) was that there was a favorable potential for pediatric dentists in a nonurban environment.

"The reduced number of dentists per population, a large backlog of needed dental services for children and an increasing demand for dental care in rural areas, could provide a favorable environment for a judicious distribution of pedodontists."[1]

Recently published pediatric dental-use-pattern data (into the second half of the 1980s), based on a distribution by urban vs nonurban residents, permit a review of the proposal for pediatric dentists to increase practice activities in nonurban areas.

EARLIER FINDINGS

Although specific urban vs nonurban pediatric dental use patterns were not available at the time of the earlier writing, the proposal for a wider distribution of successful pediatric practices was based upon the following information.

- ☐ The number of active dentists per population was far greater in metropolitan than nonmetropolitan areas.
- ☐ Eighty percent of the dental manpower shortage areas (i.e. less than one dentist per five thousand residents) were in nonmetropolitan areas.
- ☐ In past decades, urban residents reported greater use of dental services than their nonurban counterparts. More recently, residents of nonmetropolitan areas reported increasing their use of services, and residents of metropolitan communities reported limited change in their use of dental services.
- ☐ The evolving dental disease patterns and the use of dental services reflected the greater availability of public water fluoridation programs in urban areas. Children in standard metropolitan areas* (SMAs) had lower decayed, missing and filled surfaces (DMFS) rates than their nonSMA counterparts.
- ☐ Children in metropolitan areas have far less unmet dental needs than their counterparts in nonmetropolitan areas.

RECENT FINDINGS

The general population

There continue to be great variations in the distribution of dentists throughout the country. The ratio of population to dentists varies from less than 1,400 individuals per dentist in the States of Connecticut, Massachusetts, New York and Oregon and the District of Columbia to

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*Generally speaking, a metropolitan statistical area consists of a county or group of counties containing at least one city (or twin cities) having a population of 50,000 or more plus adjacent counties that are metropolitan in character and are economically and socially integrated with the central city. Towns and cities, rather than counties, are the units used in defining MSAs in New England.[2]

Table 1 ☐ Percent of the general population with a dental visit in the past year and the percent increase by place of residence: 1963/64, 1975, 1980, 1986.[2,4,5]

	1963/64	1975	1980	1986	Percent change 1963/64 to 1975	Percent change 1980 to 1986
Metropolitan stat. area	44.7%	52.7%	51.9%	58.6%	17.9%	12.9%
Nonmetro. stat. area	37.0*	45.1	45.5	52.3	25.6	14.9

*Represents the average of: Nonfarm 38.1%, Farm 35.9%.

Table 2 ☐ Number of dental visits per person in the general population and the percent increase by place of residence: 1963/64, 1975, 1980, 1986.[2,4,5]

	1963/64	1975	1980	1986	Percent change 1963/64 to 1975	Percent change 1980 to 1986
Metropolitan stat. area	1.8	1.8	1.8	2.1	0.0%	16.7%
Nonmetro. stat. area	1.1*	1.3	1.4	1.8	18.2	28.6

*Represents the average of: Nonfarm 1.2 visits, Farm 0.9 visits

more than 2,500 individuals per dentist in Arkansas and Mississippi.[3]

The greater use of dental services by metropolitan residents, as compared to their nonmetropolitan counterparts, continued into the second half of the 1980s. Nevertheless, continuing the recent pattern of change, during the 1980s, the percent of nonmetropolitan residents reporting a dental visit in the past year, compared to metropolitan residents, increased at a faster rate (Table 1).

Similarly, the number of dental visits per person reported by nonmetropolitan residents have been lower than the number of dental visits reported by metropolitan residents. Once again, during the 1980s, the number of visits per person reported by nonmetropolitan residents, compared to their metropolitan counterparts, however, increased at a faster rate (Table 2).

Table 3 ☐ Charges for dental services for the general population by place of residence: 1980.[6]

	Mean charge per visit	Mean annual charges per user of services
Metropolitan stat. area		
Central City	$60.46	$180.11
Remainder	59.43	193.94
Nonmetro. stat. area		
Urban	55.20	167.72
Rural	48.04	132.61

It should be noted that variations in expenditures for dental services by metropolitan vs nonmetropolitan residents are not available for the second half of the 1980s. Recently published data for 1980, do indicate that metropolitan residents incurred greater average charges per dental visit and annual charges per user of dental services, than did their nonmetropolitan counterparts (Table 3). Note: No attempt was made to adjust these data on expenditure for variations in cost of living in different resident sites. In addition, because of the multiplicity of services that can be provided in the course of a visit and the inability to relate charges to specific components of such services, charges by type of service were not included in published reports.[6]

Children

☐ *Number*

Despite a major concentration of the population in metropolitan areas of the country, there are 13.4 million children between two and seventeen years of age living in nonmetropolitan areas (Table 4).

☐ *Percent with dental visits*

In 1986, a smaller percentage of children in all age-cohorts living in nonmetropolitan areas than their metropolitan counterparts, reported a visit to the dentist in the previous year. The percent of nonmetropolitan area children who reported a dental visit in the previous year, however, approximated their counterparts living in central-area metropolitan communities (Table 5). Information is not available for urban vs nonurban-area children

Table 4 ☐ Number of children in millions by place of residence: 1986.[2]

	Metropolitan statistical area			Nonmetropolitan statistical area
Age	Total	Central	Noncentral	
2-4 yrs.	8.3	3.2	5.1	2.5
5-11 yrs.	17.9	6.8	11.1	5.6
12-17 yrs.	16.1	5.8	10.3	5.3
Total	44.3	15.8	26.5	13.4

Table 5 ☐ Percent of children with a dental visit in the past year by place of residence: 1986.[2]

	Metropolitan statistical area			Nonmetropolitan statistical area
Age	Total	Central	Noncentral	
2-4 yrs.	32.0%	29.1%	33.8%	29.1%
5-11 yrs.	72.3	67.5	75.1	65.7
12-17 yrs.	71.2	65.1	74.6	66.1

to demonstrate changes in data on a visit-to-visit basis, over a period of time.

☐ *Number of dental visits*

Overall, metropolitan and nonmetropolitan-area children between five and eleven years of age reported the same number of dental visits per child. Central metropolitan children had fewer visits and noncentral areas had more visits than nonmetropolitan children. Nonmetropolitan children between twelve and seventeen years reported fewer visits than metropolitan children (but equal in number to central metropolitan-area children) (Table 6).

There were variations by gender in the reported number of dental visits. Younger metropolitan female children had fewer visits than younger male children. The use pattern was reversed for nonmetropolitan younger children. In all residential areas, for children between twelve and seventeen years, females reported more visits than their male counterparts (Table 7). Once again, information is not available for urban vs nonurban-area children to demonstrate data changes, from visit to visit.

☐ *Third party dental insurance*

In 1986, children in nonmetropolitan areas had a lower rate of private dental insurance coverage than children in all sections of metropolitan areas. Overall, a greater percent of children in all resident areas had dental insurance than the general population in the respective areas (Table 8). In 1980 (the latest period for which data are available), third-party coverage for the general population, including private insurance and Medicaid, was lowest for residents of the more rural areas of the country and progressively higher through the more urban areas (Table 9).

Table 6 ☐ Number of dental visits per child by place of residence: 1986.[2]

	Metropolitan statistical area			Nonmetropolitan statistical area
Age	Total	Central	Noncentral	
2-4 yrs.	0.7%	0.7%	0.7%	0.8*
5-11 yrs.	2.0	1.5	2.3	2.0
12-17 yrs.	2.9	2.4	3.2	2.4

*Relative standard error greater than 30%

OVERVIEW

"From the practitioner's perspective, a favorable dentist to population ratio, a large backlog of needed services and an increasing demand for care would seem to be a most favorable environment for dental practice."[1]

Despite lower third-party dental insurance coverage and lower expenditures for dental services, the general population in nonurban areas, as compared to the population in metropolitan areas, is continuing to increase their use of dental services at a faster rate. Specific information is not available to demonstrate urban vs nonurban visit-to-visit data changes in children. Nevertheless, based on the general population trends and higher dental insurance coverage rates for children (and the direct relationship between insurance coverage and dental visits) it would seem reasonable to hypothesize an increasing dental-visit pattern by nonurban children.[2]

While it may be difficult to overcome practitioner preferences for practice locations, the availability of favorable practice potential in selected nonurban areas may be sufficient incentive to attract some pediatric dentists. In addition, increasing availability of dentists in nonurban areas may have a positive impact on expenditures for dental care, as well as aiding efforts to increase dental insurance coverage.[7]

Individual pediatric practices must evolve to reflect the changing patterns of dental disease and the competitive realities in today's (and tomorrow's) world. Similarly, pediatric practitioners may need to consider practice arrangements in all geographic areas which continue to demonstrate an increasing demand for services.

Table 7 ☐ Number of dental visits per child by gender: 1986.[2]

		Metropolitan statistical area			Nonmetropolitan statistical area
Age	Gender	Total	Central	Noncentral	
5-11 yrs.	Male	2.1%	1.6%	2.4%	1.8%
	Female	1.9	1.4	2.2	2.1
12-17 yrs.	Male	2.7	2.3	3.0	1.9
	Female	3.1	2.5	3.4	2.9

Table 8 ☐ Percent of children with dental insurance by place of residence: 1986.[2]

	Metropolitan statistical area			Nonmetropolitan statistical area
Age	Total	Central	Noncentral	
2-4 yrs.	44.0%	38.3%	47.6%	27.7%
5-11 yrs.	45.4	39.1	49.2	34.4
12-17 yrs.	46.1	37.8	50.9	34.2
Total pop. 2 yrs. and over	40.6%	35.3%	44.0%	28.7%

Table 9 ☐ Percent distribution of persons by type of dental coverage and place of residence: 1980.[6]

	Medicaid	Private dental insurance	No Medicaid or private dent. ins.	Unknown
Metropolitan stat. area.				
Central city	14.6%	42.9%	49.3%	3.3%
Remainder	7.8	41.3	48.1	2.9
Nonmetro. stat. area				
Urban	9.4	30.2	57.5	2.9
Rural	8.5	24.4	64.4	2.7

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THE WORLD IS ONLY HIS TEACHER

Victory over things is the office of man. Of course, until it is accomplished, it is the war and insult of things over him. His continual tendency, his great danger, is to overlook the fact that the world is only his teacher, and the nature of sun and moon, plant and animal only means of arousing his interior activity. Enamoured of their beauty, comforted by their convenience, he seeks them as ends, and fast loses sight of the fact that they have worse than no values, that they become noxious, when he becomes their slave.

Emerson, Ralph Waldo: Education. In *Three thousand years of education.* Edited by Robert Ulich, Cambridge, MA: Harvard University Press, 1954, p 579.

Case reports

Ehlers-Danlos syndrome: Historical review, report of two cases in one family and treatment needs

R. Richard Welbury, MB, BS, BDS, FDSRCS

Meekeren gave the first description of the condition known today as Ehlers-Danlos syndrome (EDS) when he described a Spaniard with an "extraordinary elasticity of the skin".[1] The first photograph of a similarly affected individual appeared in *Curiosities and anomalies of medicine* by Gould and Pyle in 1897.[2]

At the beginning of the twentieth century the condition became a recognized clinical syndrome rather than a curiosity and Ehlers, a Danish dermatologist, noted that in addition to the hyperextensibility of the skin, the joints were excessively mobile and the skin bruised easily.[3] Danlos, a French physician, drew attention to the peculiar scar and pseudotumor formation of the skin.[4] Johnson and Falls were the first to claim that EDS was a generalized disease and McKusick suggested that EDS might consist of more than one entity.[5,6] Barabas described three subgroups of the syndrome; whereas Beighton *et al*, in a review of 100 patients, recognized five distinct and clinically recognizable varieties of the condition.[7,8] Harris stated "what are at present considered single disease entities may well be found to be due to a series of distinct and different abnormalities of a single enzyme protein."[9] By 1977 an eighth clinical and genetic type had been recognized and in the interim period the biochemical defects responsible for types IV, V, VI and VII had been elicited.[11-15]

Ehlers-Danlos syndrome is, therefore, a heterogeneous collection of eight clinical types, four of which

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have been found to be caused by defects in the biosynthesis of collagen, the major structural protein of the body. The cardinal clinical features which are present in varying combinations and severity are cutaneous hyperextensibility, joint hypermobility, tissue fragility, papyraceous scarring and an increased bruising and bleeding tendency. There are a large variety of additional manifestations and complications and the range of severity of symptoms can vary appreciably according to type; in some cases there is little obvious abnormality, while in others it is a life threatening condition (Table). The minimal overall frequency has been estimated to be 1:156250.[16]

A description of the principal clinical features generally present can be grouped under four headings: skin and blood vessels, musculoskeletal system, orofacial, and additional features.

Skin and blood vessels

The skin is usually soft and velvety to the touch, demonstrating varying degrees of hyperelasticity, especially over the major joints. The fragility of the skin and oral mucosa may cause wounds that split open and gape, even after relatively mild trauma. Wounds heal slowly, particularly over bony prominences (knees, elbows, shins) and leave characteristic papyraceous scars in which the skin is atrophic, shiny, corrugated by many fine wrinkles and often hyperpigmented. Sutures hold poorly and dehiscence may occur necessitating prolonged fixation of the wound edges.

Easy bruising in EDS is common, and is frequently the presenting complaint. Other manifestations of a bleeding tendency are bleeding from the gingiva following toothbrushing or dental extraction, and rarely gastrointestinal bleeding or hemoptysis may occur. The bruising and bleeding tendencies have been attributed to increased fragility of the vessel walls and in most patients no detectable abnormality in either the platelets or plasma clotting factors is found.[11]

Additional cutaneous manifestations are the presence of subcutaneous calcified cyst-like structures developed from organizing or calcifying subcutaneous hematomas, and molluscoid pseudotumors which are subcutaneous masses of varying form and consistency, found over pressure points such as knees, elbows, heels, and shins.

Table □ Characteristics of the eight types of Ehlers-Danlos syndrome.

	Type of EDS	Cutaneous hyperextensibility	Joint hypermobility	Tissue fragility	Bruising	Major complications	Inheritance	Biochemical defect
I.	Gravis	Marked	Marked	Moderate	Moderate	Muscoloskeletal deformitites common; varicose veins; prematurity due to ruptured membranes	Autosomal dominant	Unknown
II.	Mitis	Moderate	Moderate	Moderate	Moderate		Autosomal dominant	Unknown
III.	Benign hypermobile	Minimal	Marked	Minimal	Minimal	Arthritis	Autosomal dominant	Unknown
IV.	Ecchymotic	Minimal	Digits only	Moderate	Minimal	Death from arterial rupture, aortic dissection, intestinal perforation; musculoskeletal abnormalities absent	Autosomal recessive	Type III collagen deficiency
V.	X-linked	Marked	Digits only	Minimal	Minimal	Muscoloskeletal disorders common	X-linked	Lysyloxidase
VI.	Ocular variety	Marked	Marked	Minimal	Minimal	Fragility of cornea and sclera; retinal detachment; severe scoliosis	Autosomal recessive	Lysyl hydroxylase deficiency
VII.	Procollagen peptidase deficiency	Moderate	Marked	Moderate	Moderate	Marked short stature and multiple joint disclocations	Autosomal recessive	Procollagen peptidase deficiency
VIII.	Periodontitis	Minimal	Moderate in the digits	Marked	Minimal	Advanced periodontitis, fragility of skin	Autosomal dominant	Unknown

Musculoskeletal system

Joint hypermobility is usually a primary feature depending on the type of EDS and usually both large and small joints are affected and may be severe enough to cause recurrent dislocations, including subluxation of the temporomandibular joints. Joint effusions are frequent, especially at the knee, and hemarthrosis may occur. Kyphoscoliosis may be present with thoracic asymmetry and spondylolisthesis may be a source of back pain. Congenital dislocation of the hips may be an early presentation.

Orofacial

The facies are often slightly abnormal with epicanthic folds, a broad nasal bridge and ocular hypertelorism. Bat ears are a less frequent finding and characteristic scars are often present on forehead and chin. Many of the oral manifestations of EDS, recognized by Barabas and Barabas, and Barabas can be summarized as follows:

- ☐ Fragility of the oral mucosa with delayed healing and a tendency to tear, if suturing is attempted.
- ☐ The gingivae are more prone to injury and severe bleeding may occur after toothbrushing in EDS Type IV.
- ☐ Clinically the teeth are small and conical. The premolars have high cusps and deep occlusal fissures.
- ☐ Radiographically, the teeth may have stunted or deformed roots, and large pulp stones.
- ☐ Microscopically, there are irregularities in all dental tissues, particularly at the amelodentinal and cementodentinal junctions. Dentinal tubular abnormalities and vascular inclusions are seen; which support the biochemical defect in collagen biosynthesis, since there is not significant elastic tissue content in dentine.
- ☐ In Type VIII the defect, which is as yet unknown, causes a severe and generalized periodontitis, resulting in extensive resorption of alveolar bone and premature loss of teeth.[17,18]

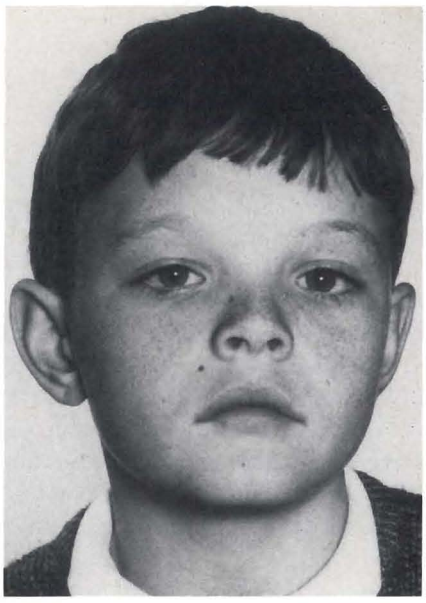

Figure 1. The patient age 9.5 years exhibiting a broad nasal bridge, ocular hypertelorism and slightly prominent bat ears.

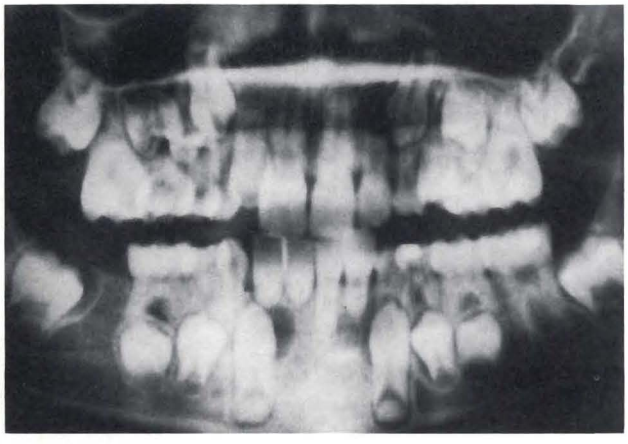

Figure 2. Panoramic radiograph showing pulp stones in all permanent incisors and lower canines, and premature closure of lower incisor apices.

Figure 3. Pulp stones affecting upper left central and lateral incisors and premature closure of apex of the lateral incisor.

Additional features

Umbilical, inguinal and hiatal herniae together with diverticulae of hollow viscera are well documented in the literature. Abnormalities of the renal collecting system may result in renal tubular acidosis, and spontaneous pneumothorax, possibly due to subpleural blebs, is an occasional finding. The most important additional feature with regard to dentistry, however, is that some patients with EDS have either the 'floppy mitral valve syndrome' (Barlow syndrome) manifested by a midsystolic click and late systolic murmur, or the combination of mitral and tricuspid insufficiency due to redundant chordae tendineae or valve cusps.[19-21] This cardiovascular problem would appear to be predominantly associated with type III (benign hypermobile); but McKusick considers that it can occur with any type.[11]

The patients in the following case reports are cousins. The older male cousin was diagnosed EDS as a result of intraoral dental radiographs, and the younger female cousin was brought to the clinic as a result of observations made by the mother of the male cousins.

CASE 1

A 9.5-year-old, healthy male attended the dental hospital, requesting routine dental care in the pedodontic department. At this time there was no medical or family history of any note, and there were no other siblings.

On examination, the patient was small for his age, and had a broad nasal bridge, ocular hypertelorism and slightly prominent ears (Figure 1). Intraoral examination showed the following teeth to be present:

6 E D C 1	1 2 C E 6
E D C 2 1	1 2 C D E 6

There was no apparent periodontal disease. Routine intraoral and panoramic radiographs showed the following teeth to be developing:

7 5 4 3 2	3 4 5 7
7 5 4 3	3 4 5 7

These teeth were unerupted with characteristic pulp stones in all permanent incisors and lower canines (Figures 2 and 3). In addition the apices of the lower incisors had closed prematurely, leaving greatly reduced root lengths and a dubious long-term prognosis for these teeth. As a result of these radiographs a diagnosis of EDS was made and further questioning and clinical examination revealed moderate cutaneous hyperextensibility (Figure 4); moderate joint hypermobility; a papyraceous scar on his left knee, which had required resuturing on two occasions (Figure 5); and a tendency to bruise easily. In the past, however, he had had three dental extractions under general anesthesia without significant bleeding. Subsequent hematological investigation revealed values within normal limits for hemoglobin, white-cell count and differential, platelets, plasma clotting screen, and platelet aggregation to ADP and collagen. Examination by a pediatric cardiologist, which included echocardiography, revealed no cardiac abnormalities.

Figure 4. Cutaneous hyperextensibility of upper eyelids.

Figure 5. Papyraceous scarring of the left knee.

CASE 2

The female first cousin of the boy in case 1 was seen in the dental hospital as a result of her aunt (the boy's mother) noting her joint hypermobility, following her son's investigations. The boy's mother and the girl's father were sister and brother and although they and their five other sisters were normal, they did recall that the sixteen-year-old daughter of one sister had died as a result of a complex cardiac defect.

The patient, age five, who had an older sister, age eight, who was fit and well, gave a history of a normal childhood, apart from an episode of excessive postoperative bleeding, following a tonsillectomy a year ago.

On examination the patient was of normal height for her age and had a normal facies. She exhibited hypermobility of the joints, but no cutaneous hyperextensibility or evidence of papyraceous scarring. Intraoral examination revealed a full primary dentition together with partially erupted lower first permanent molars. There was no caries, gingival or periodontal disease. Panoramic radiography revealed that all permanent teeth except the third molars were developing and no other stigmata of EDS was apparent.

Subsequent similar hematological investigation to that of her male cousin was normal.

Examination by a pediatric cardiologist which included echocardiography revealed no cardiac abnormality.

DISCUSSION

The diagnosis of Ehlers-Danlos syndrome has an important bearing upon subsequent dental treatment, for a number of reasons. Inferior and superior dental blocks are best avoided in EDS. The increased fragility of blood vessel walls and the reduced restraint afforded by hypertensible tissues may cause large dissecting hematomas after needle-prick damage.[17] This would probably be a real problem only with the more severely affected forms of EDS, but it would be prudent to advise intraligamentary analgesia for all forms of EDS as an alternative to inferior and superior alveolar blocks.

In the absence of a history of excessive bleeding there is little risk of prolonged hemorrhage after dental extractions or surgery. Hematological consultation on this matter should be sought, however, before beginning treatment.

The fragility of the oral mucosa, especially in more severe forms of EDS, results in a tendency to tear on suturing, even when only slight tension is applied. Periodontal surgery, scaling, and raising mucoperiosteal flaps should be done with the greatest care to minimize gingival damage and prevent lacerations. Preoperative acrylic plate construction is suggested, so suturing can be avoided in flap surgery.

Valvular abnormalities occurring in EDS have been discussed earlier and antibiotic cover must be provided for deep scaling, extractions or surgery in any EDS patient in whom cardiac abnormalities have not been excluded after examination by a cardiologist. (Infective endocarditis is at least as common today as it was fifty years ago and despite modern antibiotic therapy 15 to 30 percent of patients still die.[22]

The patients in these reports were classified as Type II Ehlers-Danlos syndrome. It was not possible to ascertain whether the first cousin who died aged sixteen had EDS.

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Dental considerations in the treatment of Wiskott-Aldrich syndrome: Report of case

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Wiskott-Aldrich syndrome is a rare, hereditary disease occurring in males and was first described in 1937.[1-3] Seventy percent of affected patients die by three years, two months of age and only a few individuals have survived to the teen years.[2] The disease is characterized by cutaneous eczema (usually beginning on the face), thrombocytopenic purpura, and an increased susceptibility to infection due to an immunologic defect.[1-4] Petechiae and a purpuric rash or ecchymoses of the skin may be early signs of the disease. The eczema may be allergic in nature.[5] These patients commonly manifest boils, otitis media, bloody diarrhea, and respiratory infection.[1-4,6-8] One of the important features of the disease is the occurrence of lymphoreticular malignant neoplasm, commonly a malignant lymphoma, which is often discovered incidentally at autopsy, although it is the specific cause of death in about 10 percent of cases.

REVIEW OF THE LITERATURE

The increased susceptibility to infection appears to be related to an antibody deficiency to polysaccharide antigens despite a normal response to protein antigens.[1-4,9-12] Serum IgM levels are low, but IgA and IgE levels may be normal or elevated. It is generally agreed that these patients have T-cell and B-cell abnormalities. The defects increase with time so that originally normal findings give way to abnormal responses.[1,4,13-18] The bone marrow contains a normal number of megakaryocytes, but may have bizarre nuclear morphology. Wiskott-Aldrich syndrome may represent an unusual circumstance in which thrombocytopenia results from abnormal platelet formation or release.[4,13-18] Because of the thrombocytopenia, (generally, counts range between 18,000 and 80,000 per cubic millimeter), these patients frequently have a prolonged bleeding time. Also, there is an undesirable alteration in the size and shape of platelets, with most being abnormally small. At the electron microscope level, there are also alterations in the cell membrane, while biochemically, there is a deficiency of the adenosine diphosphate nucleotide storage pool.[1,14-18]

Oral manifestations found in Wiskott-Aldrich syndrome include spontaneous gingival bleeding as well as bleeding from the gastrointestinal tract and the nose. Palatal petechiae are also frequently present.[1,2] With the advent of cyclosporine A therapy, hyperplastic gingiva may now be expected as a frequent complication.

There is no specific treatment for the disease and early death is a virtual certainty as the result of secondary infection or hemorrhage. Some patients have been treated with transfer factor, others with antibiotics and platelet transfusions.[19] Splenectomy with prophylactic antibiotic coverage has been utilized as a treatment modality, but this procedure has frequently been followed by overwhelming sepsis and death.[4] The current mode of therapy involves bone marrow transplantation. In contrast to combined immunodeficiency disease, ad-

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ministration of near lethal doses of cyclophosphamide or radiation therapy is necessary to prepare the patient for acceptance of the transplant. This greatly increases the morbidity and mortality of the procedure.[1,4,20,21]

REPORT OF CASE

The patient was born on November 21, 1981 and was a product of a first pregnancy for the parents. The entire pregnancy was uncomplicated. The family history indicated a suspected Wiskott- Aldrich syndrome in the maternal uncle, who died at ten months of age. The cause of death was listed as splenomegaly, anemia, and thrombocytopenia. A maternal great uncle died at four years of age of overwhelming pneumonia. He also had severe eczema. At birth, the patient demonstrated abdominal petechiae. He was evaluated at six months of age in Denver, Colorado. The evaluation and diagnosis were undertaken, due to an extended bleeding episode following lip trauma. This resulted in petechiae and the findings of small platelets (three cubic microns versus the norm of six cubic microns) and thrombocytopenia requiring platelet transfusions. The patient also had a history of eczema, otitis media, and bloody diarrhea.

The patient underwent a therapeutic splenectomy in May, 1983. He was maintained on prophylactic sodium dicloxacillin and gamma globulin. He demonstrated the classic reduced levels of IgM and elevated levels of IgA and IgE. The patient did fairly well for two years, but then suffered increasing symptoms of the disease. A bone marrow transplant was performed in Madison, Wisconsin in September, 1986. The patient suffered with graft versus host problems for several months. He returned to the Kansas City area in March, 1987.

The patient was first seen in the dental clinic at the University of Kansas Medical Center in April, 1987 with a complaint of enlarged, bleeding gingiva. A thorough dental evaluation was performed including panoramic and interproximal radiographs. The findings included severe facial eczema, poor oral hygiene, cyclosporine A induced gingival hyperplasia, and several caries lesions (Figures 1-3). The hematology staff was consulted and agreed to the necessary dental care. The patient had 313,000 platelets, Hb of 12.5, and WBC of 5.6. The patient was on prophylactic trimethoprim and sulfamethoxazole that was deemed adequate for the dental procedures by the hematology staff. A thorough dental prophylaxis with gingival curettage was performed. Three dental amalgam restorations were accomplished. Maxillary and mandibular alginate impressions were recommended with subsequent fabrication of custom

Figure 1. Facial view of patient depicting cutaneous eczema.

fluoride trays. The patient was to utilize 0.4 percent stannous fluoride in the trays for five minutes at bedtime as a prophylactic measure. The parents opted, however, for nonprescription, home fluoride-therapy. Comprehensive home care instructions were provided for the parents and the patient. All procedures were safely accomplished without complication. The patient was placed on a three month recall program, but did not return. The hematology staff reports he is currently alive and functioning fairly well.

CONCLUSION

Wiskott-Aldrich syndrome is a rare, sex-linked recessive syndrome that inevitably leads to death prior to the teen years. Since the prominent finding of the syndrome is increased susceptibility to infection, all potential prophylactic measures to prevent infection should be undertaken. Dentists frequently become involved with these patients because of the common oral manifestations of spontaneous gingival hemorrhage, palatal petechiae, and recently, cyclosporine A induced gingival hyperplasia. With the cooperation of the hematology staff, many dental procedures can be safely accomplished that can lead to increased quantity and quality of

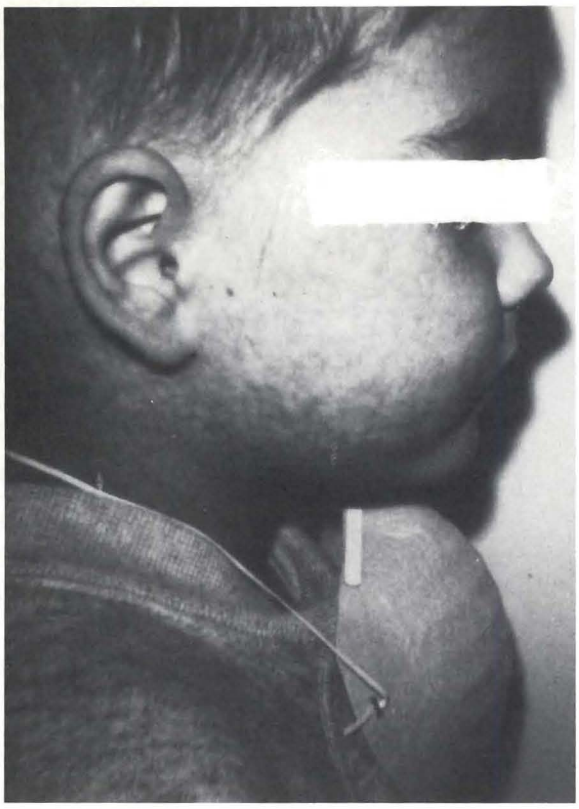

Figure 2. Profile view of patient demonstrating cutaneous eczema and sparsity of hair as a result of chemotherapy.

life. Thorough knowledge and training for the parents and patients in home care along with prophylactic fluoride therapy can help reduce hard and soft tissue infections. The utilization of common dental hemostatic procedures such as periodontal packs and trays packed with powdered thrombin can be of great benefit in controlling spontaneous gingival hemorrhage. With the advent of bone marrow transplantation as a treatment regimen, the life expectancy of patients with Wiskott-Aldrich syndrome has increased and the role of the dentist in providing care for these patients has become more important.

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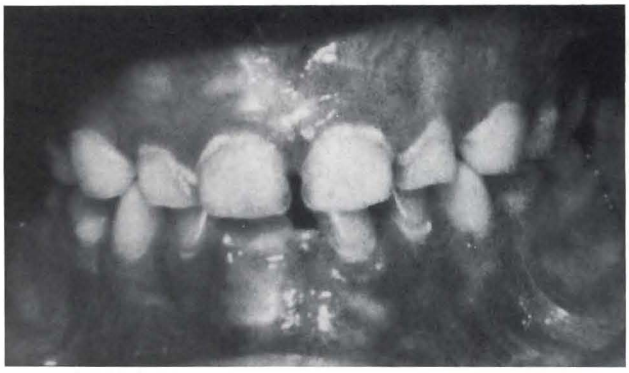

Figure 3. Intraoral view of patient demonstrating poor oral hygiene and moderate cyclosporine A induced gingival hyperplasia.

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Nutrition

Recent advances in the management of lactose intolerance

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Dairy foods are an important source of high-quality protein, riboflavin and calcium in the diets of children and adults in the United States, Canada, Europe and other countries with a dairy industry. Up to 70 percent of the world's population, however, may develop gastrointestinal symptoms, including excessive gas production, pain and diarrhea following consumption of lactose- containing dairy foods. Young mammals, including humans, have a high level of lactase activity in the lining of their upper intestines, since they depend on lactose as the primary carbohydrate in their diets. As mammals mature and are weaned, lactase activity in the intestine is greatly reduced. Like other mammals, most humans (approximately 70 percent)lose the majority of their intestinal lactase activity after weaning. Individuals who lose their intestinal lactase have been described as lactase-deficient, lactase nonpersistent or lactose malabsorbers.

What is unique is that a small portion of the wordd's population (approximately 30 percent, including descendants of some African and Middle Eastern Tribes and most Northern Europeans) have apparently adapted to maintain the lactase enzyme. Research strongly suggests that this adaptation is genetically controlled, permanent and is related to the development of dairying in these regions of the world several thousand years ago.[1]

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For those individuals who maintain the lactase enzyme, eating dairy foods will not cause lactose intolerance problems. But individuals who are lactase nonpersistent will malabsorb a significant portion of a dietary load in the small intestine. Lactose which is not digested in the small intestine reaches the large intestine where it is digested by the microflora, forming lactic acid, shortchain fatty acids (SCFA) and hydrogen gas. The SCFAs are rapidly absorbed by the intestine and are a source of energy. Presumably, when the lactose concentration of the large intestine exceeds the ability of the bacteria to digest it, osmotic pressure results in increased motility, pain, loose stool and diarrhea. The purpose of this article is to provide an overview of the recent research findings relating to the dietary management of lactose intolerance.

LACTOSE INTOLERANCE SYMPTOMS ARE RELATED TO THE AMOUNT OF LACTOSE CONSUMED

Scientists and clinicians have recognized for some time that the majority of lactose malabsorbers will not develop symptoms of intolerance following the consumption of a single eight-ounce serving of milk containing approximately 12g of lactose. Newcomer and McGill, Savaiano and Levitt and recently Scrimshaw and Murray have reviewed the research findings relating dose of lactose to the development of symptoms with the uniform conclusion that, at most, only one-fifth to one-third of malabsorbers will develop symptoms following this physiological dose of lactose.[2-4]

Further, the level of symptom response to one glass of milk is not very different from that observed with lactose-free, flavored placebo beverages, although such controls may be criticized for their high osmotic loads.[5] Increasing the dose of lactose to 24g (found in two glasses of milk) increases the incidence of symptoms to a range close to 50 percent. Increasing the dose further, toward 50g of lactose (approximately one liter of milk) increases the incidence and severity of symptoms. A 50g lactose load has been used historically to test for the presence of lactose malabsorption. Unfortunately, the extensive and relatively severe symptoms resulting from this unphysiologic lactose load have tended to develop and reinforce the misconception and any lactose load will cause symptoms in lactose malabsorbers.

A corollary to this misconception is the unfounded belief that all dairy foods will cause lactose-intolerance symptoms. Lactose is a water-soluble disaccharide that remains primarily with the whey portion of dairy foods.

Table 1 ☐ Lactose in common daily foods.

Food	Lactose (percent)
Cow's milk	
Whole	4.7
Skim	5.0
Yogurt (lowfat)	4.0-4.6
Cream	3.0
Cottage cheese	1.4
Hard cheeses	trace
Ice cream (14% fat)	3.6
Milk chocolate	8.1

(Savaiano and Levitt, 1987)

As such, hard cheeses (with the whey removed from the curds) contain very little lactose (Table 1).[3] Cottage cheese, ice creams and yogurts contain reduced amounts of lactose relative to milk and, therefore, cause fewer symptoms. A special attribute of yogurt, its microbial beta-galactosidase, which assists the digestion of lactose *in vivo*, will be discussed later in this review.

INGESTION OF LACTOSE WITH OTHER NUTRIENTS REDUCES INTOLERANCE

The quantity and type of foods consumed along with lactose appear to be a second important factor in determining the incidence of symptoms. In controlled experiments evaluating lactose intolerance, researchers have typically fed lactose in water or milk. Such experimental designs probably result in a higher incidence of symptoms than the typical consumer might experience, since consumers often drink milk with other foods.

In 1973, Leichter convincingly demonstrated reduced malabsorption and improved tolerance to lactose consumed in whole milk as compared to skim milk or water.[6] Pirk and Scala reported that in malabsorbers, stomach emptying is delayed with lactose (versus sucrose) feeding, whereas small intestinal transit is more rapid.[7] Chocolate milk also appears to delay stomach emptying, presumably due to the greater osmotic load.[8] The delay in gastrointestinal transit of lactose by other nutrients appears to be significant in slowing malabsorption and reducing the development of intolerance symptoms. Both Solomons *et al* and Martini and Savaiano recently published experiments showing delayed transit of lactose to the colon (as measured by breath hydrogen) when lactose is consumed with a meal.[9,10] In Martini and Savaiano's study, both the severity and incidence of symptoms were reduced three-fold so that only 25 percent of the subjects experienced symptoms of any kind, following a 20g lactose load consumed with a breakfast meal (Table 2).[10]

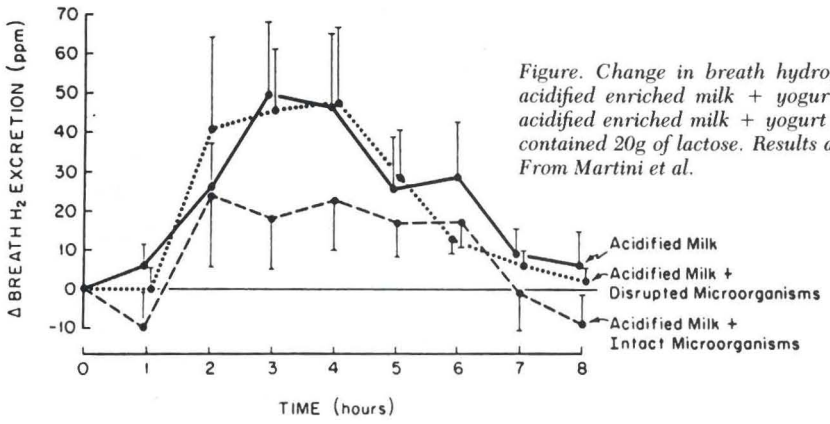

Figure. Change in breath hydrogen (ppm) after ingestion of acidified enriched milk, acidified enriched milk + yogurt microorganisms with disrupted cell structures, and acidified enriched milk + yogurt microorganisms with intact cell structures. Each meal contained 20g of lactose. Results are the mean ± SEM for five lactase-deficient subjects. From Martini et al.

LACTOSE DIGESTION FROM YOGURTS AND OTHER FERMENTED DAIRY FOODS

Since the work of Gallagher, *et al* and Alm in the 1970s, it has been suggested that fermented dairy foods may be tolerated better than similar unfermented products.[11,12] Several reasons were typically invoked to explain the phenomenon including the lower lactose levels found in these foods and the contribution to digestion that lactic acid bacteria might make.[12,13] Work by Kilara and Shahani and Goodenough and Kleyn indicated that the bacteria used in yogurt cultures *Streptococcus thermophilus* and *Lactobacillus bulgaricus* contain a beta-galactosidase activity and that this activity could possibly enhance lactose digestion *in vivo* in the rodent gastrointestinal tract.[14,15] Such findings led Kolars, *et al* and Gilliland and Kim to evaluate lactose digestion from yogurt containing controlled amounts of lactose.[16,17]

In January of 1984, both groups reported a significant reduction in malabsorption as measured by breath hydrogen production. In addition, Kolars *et al* were able to demonstrate a significant reduction in intolerance symptoms with yogurt feeding and the presence of yogurt beta-galactosidase activity in the duodenums of yogurt-fed subjects.[16] The enhanced digestion of and tolerance to lactose from yogurt has been replicated by several investigators.[18-24] In contrast, a recent study failed to show a significant reduction in symptoms following yogurt feeding, apparently due to a low level of symptoms resulting from the control lactose load.[25]

The mechanism by which the yogurt-borne microbial beta- galactosidase can facilitate lactose digestion *in vivo* in the gastrointestinal tract is not completely understood. It appears that an intact microbial cell structure is critical for the survival of the enzyme during gastric digestion.[19] Sonication or heating to disrupt the cell structure significantly elevates malabsorption while reducing the survival of the enzyme *in vitro* (Figure 1).[17,19] The pH of the stomach may be a second critical factor since the yogurt culture beta-galactosidase is rapidly destroyed *in vitro* at pHs $\leq$ 3.0.[19]

It should be further noted that yogurt is an excellent buffer of acid, due to its casein, lactate and calcium phosphate content. This buffering capacity may keep portions of the stomach above pH 3.0 following ingestion of yogurt meal.[19] Once the intact yogurt bacteria enter the small intestine, bile acids are hypothetically able to disrupt the cell structure, releasing enzyme into the lumenal contents. *In vitro*, bile will disrupt yogurt bacteria, releasing beta-galactosidase activity.[17] The *in vivo* action of physiological concentrations of bile acids on yogurt bacteria, however, has not been demonstrated.

Table 2 ☐ Ranking of severity and number of subjects with intolerance symptoms.*

	Meal				
	Acqueous lactose	Skim milk	Food supplement	Breakfast meal	Breakfast + Supplement
Lactose	19g	12g	19g	0	19g
Mean +/− sem	3.17 +/− 0.42	2.00 +/− 0.49	2.17 +/− 0.52	0.8 +/− 0.08	0.83 +/− 0.47
Number subjects with symptoms	12/12	8/12	9/12	1/12	3/12

*Ranking of severity of symptoms: 0. No symptoms; 1. Mild gas and/or borborygmi; 2. Excessive gas; 3. Severe gas and/or cramps; 4. Loose stools; 5. Severe diarrhea.

(Adapted from Martini and Savaiano, 1988)

The beta-galactosidase from yogurt culture is sensitive to freezing. After one week, beta-galactosidase activity fell to 34 percent of the original activity when yogurt was frozen at -14 C and to 73 percent of the original activity when frozen at -70 C.[20] Commercially manufactured frozen yogurts apparently vary from no beta-galactosidase activity to activities observed with the freezing of fresh yogurt.[20,26]

Results from Savaiano *et al* indicate that cultured milks ("buttermilks") do not improve lactose digestion or reduce intolerance symptoms among lactose malabsorbers, probably because of the different lactose metabolizing pathway found in the lactic acid bacteria used to formulate these products.[18]

Cultured milks are typically fermented with *Streptococcus lactis* or *Streptococcus cremoris* and *S. lactis* subspecies *diacetylactis*. These microbes have a phospho-beta-galactosidase that utilizes phosphorylated lactose as a substrate.[27] The phosphorylation requires a functional permeability system (intact cell membrane).[27] Apparently, there is either insufficient phospho-beta-galactosidase in cultured milk or more likely, the cell membrane phosphorylation system is disrupted during digestion, thus preventing significant digestion of lactose *in vivo*. Disruption of the cell structure *in vitro* by sonication results in only trace "lactase" activity in cultured milks.[18]

LACTOSE DIGESTION FROM UNFERMENTED ACIDOPHILUS MILK

Several research groups have evaluated the ability of unfermented milk containing *Lactobacillus acidophilus* to modify lactose digestion and the development of intolerance symptoms.[18,28,29,30] *L. acidophilus* strain NCFM has been most extensively studied. This strain is derived from human fecal samples, has been available commercially for several years and synthesizes a beta-galactosidase.[31,32]

In 1981, Payne *et al* reported no improvement in lactose malabsorption after feeding commercially available acidophilus milk for one or eight days.[28] Unfortunately, the number of viable lactobacilli and the beta-galactosidase activity of the product were not evaluated. Utilizing defined acidophilus products with 10^6, 10^7 or 10^8 viable NCFM strain lactobacilli per ml, Kim and Gilliland in 1983 showed a moderate but significant reduction in initial breath hydrogen production (approximately 15-20 ppm) with the 10^6 (two experiments) and 10^8 doses but no improvement with the 10^7 dose.[29] Breath hydrogen production was measured for only three to four hours after the test meal. Feeding acidophilus milk for eight consecutive days did not improve the absorption beyond that observed with a single meal. Unfortunately, Kim and Gilliland did not report intolerance symptoms nor did they measure the beta-galactosidase activity of the products. Newcomer *et al* also in 1983, reported no improvement in intolerance symptoms with the substitution of acidophilus milk (10^6 cells/ml of the NCFM strain) for milk in mixed diets of lactose malabsorbers.[30] Milk (or acidophilus milk) intakes varied from 0.25 to 4.5 glasses per day in a randomized, double-blind, cross-over design. Each treatment lasted one week. Symptoms were identical for the acidophilus milk and control milk periods. No estimate of lactose malabsorption was made in this study.

In 1984, Savaiano *et al* reevaluated the possible improvement of lactose digestion from acidophilus milk manufactured using frozen concentrates of the NCF strain (standard manufacturing procedure).[18] The produce contained 10^7 cells/ml. No improvement in lactose digestion (as measured by breath hydrogen) or relief from intolerance symptoms were observed. Interestingly, the acidophilus milk contained no detectable beta-galactosidase activity. Recent knowledge regarding the activity of beta- galactosidase from yogurt cultures indicates that active cultures in log or stationary phase of growth (as in yogurt) contain substantially elevated beta-galactosidase activity.[20,33,34] Activity is rapidly lost with freezing, although cell counts remain fairly constant. Cell wall and membrane damage of *L. acidophilus* during freeze drying and vacuum drying has been documented.[35]

It is likely that the lack of success in formulating effective acidophilus milks may be, at least in part, due to the use of frozen concentrate starter cultures. Another potential variable which could alter the activity of beta-galactosidase in the intestinal tract is the bile sensitivity of the strain. Gilliland *et al* have shown that growth rates of *L. acidophilus* strains vary considerably in bile-containing media.[37] Theoretically, a bile-sensitive strain would be more likely to release its beta-galactosidase *in vivo*, thereby aiding lactose digestion. In accord with this hypothesis, McDonough *et al* recently reported the improved digestion of lactose from sonicated acidophilus milk.[21] The product was formulated from frozen concentrates (NCFM strain, 10^8 cells/ml) and sonicated to disrupt the cell structure just before consumption. The release of beta- galactosidase reduced breath hydrogen production from 28ppm to 12ppm, suggesting that bile-sensitive strains, where beta- galactosidase is released *in vivo*, could be effective in improving lactose digestion.

ENZYME TABLETS

An additional approach to prevent intolerance symptoms is the use of commercially available lactose-digesting enzyme tablets. Several brands are commonly available. If instructions are followed, these products appear to be effective in reducing and/or eliminating symptoms. The tablets are either added to milk the night before drinking to predigest most of the lactose or they are taken with the dairy food (sprinkled over ice cream for example) and work in the stomach or intestine to supplement the body's lactase just like yogurt. Experiments confirm the effectiveness of these enzyme preparations either as a means of producing low- lactose milk or as a dietary adjutant.[28,38-45]

COLONIC ADAPTATION TO LACTOSE

As described by Scrimshaw and Murray, lactase-deficient persons who routinely eat lactose-containing foods adapt to exhibit fewer symptoms.[46-50] Such observations result, in part, from research aimed at determining if the mammalian small intestinal lactase can adapt to the long-term ingestion of lactose. It appears that the mammalian lactase is a nonadaptable enzyme.[46,51] Incidental to these findings, however, researchers noted that both rodents and humans exhibit fewer symptoms of intolerance after "adapting" to a lactose-containing diet. Studies in rodents, chickens and pigs also show that the large intestine bacteria adapt to ongoing lactose-containing diets.[52-55] Fecal microbial beta-galactosidase increases three- to six-fold in such experiments. Concurrent with this increase in lactose-digesting capacity is a reduction in malabsorption symptoms. Whether this increased enzyme activity is due to induction in existing microbes or an alteration in the microbial population is not known.

In humans, Florent *et al* have completed elegant work showing similar adaptation to lactulose. Lactulose is a nondigestible disaccharide of fructose and galactose. Administration of 20g of lactulose twice per day for eight days resulted in a six-fold increase in fecal beta-galactosidase activity, increased cecal ^{14}C-lactulose oxidation, lactic acid and SCFA production and a reduction in breath hydrogen production, In a follow-up study, adaptation to lactulose resulted in slower transit times and reduced incidence of diarrhea from a single lactulose load.[57] Similar controlled experiments with lactose feeding are not available, but recent studies suggest that lactose digestion may improve during pregnancy (when milk consumption might be increased) and worsen with aging (when milk consumption might decline).[58,59] The role of the large intestine bacteria in these reported adaptations is unknown. Additional research is needed in order to determine if the intestinal bacteria hold the key to preventing the gastrointestinal intolerance symptoms that can occur in lactase-deficient persons.

LACTASE NONPERSISTENCE, LACTOSE CONSUMPTION AND CALCIUM ABSORPTION

Interest in the effect of lactose on calcium absorption among lactose malabsorbers has grown with the recognition that a significant portion of patients with osteoporosis also exhibit signs of lactose malabsorption.[60-64] Early research on the influence of lactose on calcium absorption among lactose malabsorbers is inconsistent, showing both improvement and reduction in calcium availability.[65-67] In 1973, Kocian *et al* reported that the consumption of 39g of lactose (as compared to 39g of glucose) resulted in a delayed calcium absorption among lactase-persistent subjects. The overall retention of labeled calcium (measured after 7 days) however, was not different between absorbers and malabsorbers, suggesting only a slowed rate but not a reduction in the absolute amount of calcium absorbed.

In 1983, Cochet *et al* using dual-label methods, found a reduction in total fractional calcium absorption from 0.255 to 0.209 ($p<0.005$) when the calcium was fed with 50g of lactose to young adult malabsorbers.[69] In lactase-persistent adults, 50g of lactose increased total fractional calcium absorption from 0.224 to 0.356 ($p<0.001$). Using physiological doses of lactose (7.5g to 10.3g) in milk, Smith *et al* reported no difference in ^{45}calcium absorption between lactose malabsorbers and lactase- persistent adults.[70] Further, malabsorbers absorbed slightly more calcium from yogurt than did lactase-persistent adults ($p<0.05$). Although the number of subjects studied was small (nniques, Tremaine *et al* found similar results when either 240 ml of milk (containing approximately 10-12g of lactose) or lactose-hydrolyzed milk was fed to 10 lactase-persistent and 10 lactase-nonpersistent adults.[71] No differences in calcium absorption were observed between milks, whereas lactose malabsorbers absorbed significantly more calcium from both milks ($p<0.01$), possibly reflecting lower dietary calcium intakes. In summary, these studies suggest that physiological doses of lactose do not inhibit calcium absorption among lactose malabsorbers. Large unphysiological doses of lactose, possibly due to intestinal secretions and/or shortened transit times, however, may reduce calcium uptake.

SUMMARY

Lactose intolerance is a concern for the majority of the world's population. Persons who experience symptoms following the consumption of milk should consult with their physician. Symptoms may be eliminated or reduced with good dietary management that includes:

- ☐ Limiting milk consumption to one glass at a time.
- ☐ Drinking milk with other foods rather than alone.
- ☐ Eating yogurts instead of fluid milk.
- ☐ Using enzyme tablets to predigest the lactose in milk or to supplement the body's own lactase.
- ☐ Possibly eating small amounts of dairy foods each day to adapt the colonic bacteria.

For an additional review of the research findings on lactose intolerance and milk drinking, the reader is directed to reference 4, a very recent and complete review by Scrimshaw and Murray. For information on dietary management of lactose intolerance suitable for the consumer, contact your local affiliate of the National Dairy Council.

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ABSTRACTS

Simard, Paul L.; Lachapelle, Diana; Trahan, Luc; Naccache, Hermine; Demers, Marie; Brodeur, Jean-Marc: The ingestion of fluoride dentifrice by young children. J Dent Child, 56:177-181, May-June, 1989.

Few studies on toothpaste ingestion by young children have attempted to determine the quantity of fluoride that can be swallowed during toothbrushing. This pilot study was undertaken to determine a) the proportion of dentifrice ingested, compared to the quantity used by young children; b) the quantity of fluoride ingested during toothbrushing; and c) the influence of mouthrinsing on the quantity of fluoride ingested. Twenty-three children between ages 2 and 5, living in nonfluoridated communities, brushed their teeth once with a fluoride dentifrice under supervision. During toothbrushing all expectorated saliva, liquids and gel were collected; fluoride was determined with an Orion fluoride-specific electrode. The ingested amounts of dentifrice used decreased with age. The difference is statistically significant between children of 2 or 3 and 5 years of age. The amount of ingested fluoride averaged 0.33 mg per brushing. Children who do not rinse their mouths ingest 0.49 mg of F at each brushing, compared to 0.28 mg for those who did rinse.

Dentifrice, fluoride; Toothpaste ingestion

Flaitz, Catherine M.; Barr, Elizabeth, S.; Hicks, M. John: Radiographic evaluation of pulpal therapy for primary anterior teeth. J Dent Child, 56:182-185, May-June, 1989.

The goal of pulpal therapy is to prolong the retention of primary anterior teeth in order to preserve normal function and esthetic quality of the child's early dentition, without compromising the health of the permanent incisors. In this study of 144 anterior primary incisors with formocresol pulpotomies or pulpectomies, those eighty-seven with the pulpectomy procedure had the better prognosis. This may be the treatment of choice when the extent of pulpal involvement cannot be determined.

Periodic radiographic observation is important.

Primary teeth; Incisors; Evaluation, radiographic; Pulpotomy; Pulpectomy

Tandon, Shobha; Kumari, Retna; Udupa, Saraswathi: The effect of etch-time on the bond strength of a sealant and on the etch-pattern in primary and permanent enamel: an evaluation. J Dent Child, 56:186-190, May-June, 1989.

The high incidence of occlusal caries susceptibility in children rates as a major dental public health problem, due to various technical difficulties still existing in the use of pit-and-fissure sealants. The optimum etch-time in primary enamel is one of the most controversial issues among the manipulative variables of resin sealants. The present study was performed to establish laboratory evidence of a minimum etch-time of primary enamel for effective retention of occlusal sealants. It was found that an etch-time of 15 seconds was sufficient for proper bonding and gave good retentive conditions of sealant for primary teeth. Salivary contamination of etched enamel even for 1 second may cause failure of bonding of sealant. A perfectly dry field must be maintained while using sealants.

Sealants; Retention rates; Etch-times; Saliva; Bonding

Lahti, Satu; Tuutti, Heikki; Honkala, Eino: The relationship of parental dental anxiety and child's caries status. J Dent Child, 56:191-195, May-June, 1989.

The aim of this study was to determine whether dental anxiety of parents is associated with the caries status of their children. The DMF and dmf scores of 158 children aged 11-12 years, and their parents were examined. The children were divided into two groups (caries-free and caries-active) according to their previous caries experience. The data about dental anxiety (DAS), oral hygiene habits, sugar intake and socioeconomic status were collected from the families by means of a questionnaire. The level of dental anxiety was higher among caries-active children. The dmf of the children was associated with the DAS of their fathers. When explaining the caries experience of the caries-active children by multiple regression analysis the following variables were found to be best explaining factors: DAS of the fathers (9.5 percent); DMF of the mothers (7.6 percent); DMF of the fathers (3.0 percent); DAS of the child (3.0 percent). An association seems to exist between the dental anxiety of the parents and the caries status of their children. The father's anxiety seemed to be more important than that of the mother.

Dental anxiety; Pedodontic patients; Parental attitudes; Caries status

Weerheijm, Karin L.; van Amerongen, Willem E.; Eggink, Christiaan O.: The clinical diagnosis of occlusal caries: a problem. J Dent

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ABSTRACTS

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Child, 56:196-200, May-June, 1989.
Sealants and preventive composite restorations are improved methods that are each influenced by an unreliable, traditional method of diagnosing caries, especially of the occlusal surface. This study evaluated the clinical procedures used to diagnose occlusal caries and also considered the availability of other diagnostic methods, either more reliable than or supplementary to the examination with mirror, probe, and light, still the principal diagnostic tools. Twenty of twenty-six teeth here were affected by occlusal caries.
Caries; Occlusal surfaces; Diagnosis

Kozai, Katsuyuki; Iwai, Taisuke; Miura, Kayuo: Residual contamination of toothbrushes by microorganisms. J Dent Child, 56:201-204, May-June, 1989.
The use of mouth-cleaning instruments is essential; however, standard procedures for maintaining their cleanliness have proven inadequate. In this study, the microorganisms on toothbrushes used by children, and rinsed routinely, were counted using five mediums. The results showed that many oral microorganisms remained on the toothbrushes immediately after rinsing. Even after drying in air for 24 hrs, microorganisms were detected on all toothbrushes. The number of microorganisms varied according to the drying time and the skill in cleaning the toothbrush.
Oral hygiene; Toothbrushing; Pedodontics; Microorganisms; Oral pathogens; Contamination; Sterilization

Freeman, Linda; Martin, Susan; Rutenberg, Gary; Shirejian, Patricia; Skarie, Mary: Relationships between def, demographic and behavioral variables among multiracial preschool children. J Dent Child, 56:205-210, May-June, 1989.
This study surveyed 891 low-income black, white, Hispanic and Asian preschoolers for decayed, extracted, and filled teeth. It focused on relationships between def and demographic variables; parental characteristics, nutritional characteristics, and oral health practices. Fewer than 10 percent of these preschoolers had ever seen a dentist, and 23 percent had at least 1 def. Hispanic children had the highest overall def values, followed by Asian children. High def was associated with low milk intake, high sugar intake, late weaning, and less maternal involvement in toothcleaning. High def was also associated with less maternal education, except among Hispanics for whom the reverse was true. Study implications included targeting Asian and Hispanic families for early dental education, and stressing weaning by age 1 year and parental involvement in toothcleaning until age 5 for all groups.
Demographics; Behavior; Pedodontics; Multiethnicity; def scores

Waldman, H. Barry: Special pediatric population groups and their use of dental services. J Dent Child, 56:211-215, May-June, 1989.
A review is provided of special pediatric populations, their need for and use of dental services, and which practitioners provide the needed services. Moreover, it is the pediatric dentist who is now being called on to treat the dental needs of a "new" special patient population, survivors of now-chronic disease conditions that had formerly been lethal, including cancer and AIDS. Treatments can produce an entire range of morbidities as well, some of which have orofacial manifestations.
Pediatrics; Handicapped children; Special populations; Delivery of dental services

Waldman, H. Barry: Continuing potential for pediatric dental services in nonurban areas. J Dent Child, 56:216-219, May-June, 1989.
An update is provided on the dental use pattern of the 13.4 million nonurban American children. An accelerated rate of their use of services, in nonmetropolitan areas, portends a continuing favorable potential for services by pediatric dental practitioners.
Pediatric dentistry; Population trends; Delivery of dental services

Welbury, R. Richard: Ehlers-Danlos syndrome: Historical review, report of two cases in one family and treatment needs. J Dent Child, 56:220-224, May-June, 1989.
Two cases of Ehlers-Danlos syndrome are presented, one of which was diagnosed as a result of intraoral dental radiographs. The treatment needs of these patients are discussed and the importance of referral for cardiological investigation is stressed.
Ehlers-Danlos syndrome

Boraz, Robert A.: Dental considerations in the treatment of Wiskott-Aldrich syndrome: Report of case. J Dent Child, 56:225-227, May-June, 1989.
Wiskott-Aldrich syndrome is a rare, sex-linked recessive anomaly first described in 1937. About 70 percent of affected individuals die shortly after the age of three years. The disease is characterized by cutaneous eczema, thrombocytopenic purpura, and an increased susceptibility to infection. Oral manifestations include spontaneous gingival hemorrhage and palatal petechiae. With the advent of bone marrow transplantation in the treatment of Wiskott-Aldrich syndrome, gingival hyperplasia secondary to cyclosporine A therapy can also be expected. The report of a dental rehabilitation of a patient with Wiskott-Aldrich syndrome is described. Treatment recommendations for similar cases are presented.
Wiskott-Aldrich syndrome

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Further program details and registration form will appear in the July-August issue of JDC.